FOR·THE·INCREASE·AND·DIFFVSION·OF·KNOWLEDGE·AMONG·MEN·
PER ORBEM
·SMITHSONIAN·INSTITVTION·
·WASHINGTON·1846·

SHOUT
SHARE
IT

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
BULLETIN 82

A MONOGRAPH
OF THE EXISTING CRINOIDS

BY

AUSTIN HOBART CLARK

VOLUME 1
THE COMATULIDS

PART 4b.—SUPERFAMILY MARIAMETRIDA (concluded—the family Colobometridae) and SUPERFAMILY TROPIOMETRIDA (except the families Thalassometridae and Charitometridae)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1947

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price $2.75.

PREFACE

Parts 3, 4, and 5 of Volume 1, Bulletin 82, include the systematic discussion of the species and higher groups of living comatulids, or unstalked crinoids. Part 3, published on March 21, 1931, included the account of the superfamily Comasterida. Part 4a, published on August 5, 1941, included the account of the superfamily Mariametrida, with the exception of the family Colobometridae. Part 4b, the present part, is a continuation of Part 4a and contains the account of the family Colobometridae of the superfamily Mariametrida, and of the families Tropiometridae, Calometridae, Ptilometridae, and Asterometridae of the superfamily Tropiometrida.

CONTENTS

Page
Preface ... III
Order Comatulida (continued) ... 1
  Suborder Oligophreata (continued) ... 1
    Superfamily Mariametrida (continued) ... 1
      Family Colobometridae ... 1
        Genus Pontiometra ... 9
          Pontiometra andersoni ... 10
        Genus Basilometra ... 21
          Basilometra boschmai ... 22
        Genus Epimetra ... 25
          Epimetra nympha ... 25
        Genus Cenometra ... 26
          Cenometra bella ... 27
          Cenometra herdmani ... 43
          Cenometra cornuta ... 44
          Cenometra emendatrix ... 46
        Genus Cotylometra ... 48
          Cotylometra gracilicirra gracilicirra ... 49
          Cotylometra gracilicirra ornata ... 51
        Genus Austrometra ... 52
          Austrometra thetidis ... 53
        Genus Gislénometra ... 57
          Gislénometra perplexa ... 57
        Genus Oligometrides ... 61
          Oligometrides adeonae ... 62
        Genus Analcidometra ... 77
          Analcidometra armata ... 79
          Analcidometra caribbea ... 84
        Genus Iconometra ... 88
          Iconometra speciosa ... 91
          Iconometra bellona ... 93
          Iconometra japonica ... 94
          Iconometra anisa ... 97
          Iconometra marginata ... 102
          Iconometra intermedia ... 103
        Unidentifiable species ... 104
        Genus Petasometra ... 105
          Petasometra helianthoides ... 105
          Petasometra clarae ... 109
        Genus Alisometra ... 112
          Alisometra owstoni ... 113
          Alisometra longipinna ... 115

Order Comatulida (continued)
  Suborder Oligophreata (continued)
    Superfamily Mariametrida (continued)
      Family Colobometridae (continued)

Page

- Genus Colobometra 116
  - Colobometra perspinosa 117
  - Colobometra perspinosa var. vepretum 124
  - Colobometra discolor 128
  - Colobometra suavis 132
  - Colobometra arabica 132
  - Colobometra diadema 133
- Genus Cyllometra 134
  - Cyllometra prashadi 136
  - Cyllometra manca 137
  - Cyllometra gracilis 169
- Genus Decametra 170
  - Decametra zebra 175
  - Decametra chadwicki 176
  - Decametra tigrina 178
  - Decametra alaudae 183
  - Decametra taprobanes 185
  - Decametra arabica 187
  - Decametra mylitta 188
  - Decametra mollis 191
  - Decametra brevicirra 193
  - Decametra pava 195
  - Decametra minima 196
  - Decametra laevipinna 197
  - Decametra studeri 200
  - Decametra informis 203
  - Decametra modica 205
  - Decametra sp 208
- Genus Oligometra 208
  - Oligometra carpenteri 210
  - Oligometra serripinna 216
  - Oligometra serripinna serripinna 217
  - Oligometra serripinna var. macrobrachius 232
  - Oligometra serripinna var. imbricata 236
  - Oligometra serripinna var. erinacea 237
  - Oligometra serripinna var. occidentalis 239
  - Oligometra serripinna var. electrae 241
  - Oligometra serripinna caledoniae 241
  - Oligometra serripinna chinensis 244
- Genus Clarkometra 246
  - Clarkometra elegans 247
- Genus Embryometra 251
  - Embryometra mortenseni 251
- Unidentifiable species 259

Superfamily Tropiometrida 255
  Family Tropiometridae 259
    Genus Tropiometra 260
      Tropiometra magnifica 266
      Tropiometra afra afra 268
      Tropiometra afra macrodiscus 272
      Tropiometra carinata clarki 281

- Order Comatulida (continued)
  - Suborder Oligophreata (continued)
    - Superfamily Tropiometrida (continued)
      - Family Tropiometridae (continued)
        - Genus Tropiometra (continued)

Page

          - Tropiometra carinata carinata 291
          - Tropiometra carinata indica 337
          - Tropiometra carinata audouini 342
      - Family Calometridae 346
        - Genus Reometra 347
          - Reometra mariae 348
        - Genus Gephyrometra 351
          - Gephyrometra versicolor 351
        - Genus Neometra 355
          - Neometra gorgonia 356
          - Neometra sibogae 358
          - Neometra diana 360
          - Neometra sappho 361
          - Neometra acanthaster 363
          - Noemetra spinosissima 364
          - Neometra conaminis 366
          - Neometra alecto 367
          - Neometra multicolor 369
        - Genus Pectinometra 375
          - Pectinometra carduum 376
          - Pectinometra magnifica 377
          - Pectinometra flavopurpurea 379
        - Genus Calometra 385
          - Calometra discoidea 386
          - Calometra callista 390
      - Family Ptilometridae 393
        - Genus Ptilometra 394
          - Ptilometra macronema 396
          - Ptilometra australis 403
      - Family Asterometridae 415
        - Genus Pterometra 416
          - Pterometra venusta 418
          - Pterometra splendida 420
          - Pterometra trichopoda 421
          - Pterometra magnipeda 426
          - Pterometra pulcherrima 427
        - Genus Asterometra 432
          - Asterometra mirifica 434
          - Asterometra cristata 437
          - Asterometra longicirra 439
          - Asterometra macropoda 441
          - Asterometra anthus 444
          - Asterometra sp 459
- Index 461

A MONOGRAPH OF THE EXISTING CRINOIDS

By Austin Hobart Clark

Order COMATULIDA A. H. Clark (continued)

The general account of this order, with the synonymy, diagnosis, range, and keys to the included families and higher groups, will be found in Part 3, pp. 69–74.

Suborder OLIGOPHREATA A. H. Clark (continued)

The synonymy, diagnosis, range, and history of this suborder will be found in Part 3, pp. 74–76.

Superfamily MARIAMETRIDA Gislén (continued)

The synonymy, diagnosis, and general account of this superfamily will be found in Part 4a, pp. 74–79.

Family COLOBOMETRIDAE A. H. Clark

Milberti group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 192. For additional references see Part 4a, p. 180.

Palmata group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 223. For additional references see Part 4a, p. 391.

Andersoni group P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 307 (in Series I of *Antedon;* related to the *Elegans* group; characters).

Himerometridae (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135; Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (includes *Oligometra, Cyllometra, Himerometra,* and *Pontiometra*).

Colobometridae A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 145 (no description; new species of *Cenometra* and *Cyllometra* described under this heading), p. 174 (referred to the Comatulida Oligophreata); Vid. Medd. Nat. Foren. København, 1909, p. 174 (diagnosis; includes *Oligometra, Cyllometra, Colobometra,* and *Cenometra*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (6 species in Africa), p. 8 (species on the southeast coast), p. 9 (species on the northeast coast), p. 649 (referred to the Comatulida Oligophreata); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 438 (4 genera and 6 species in Australia); Mem. Australian Mus., vol. 4, 1911, p. 717 (proportionate number of species according to P. H. Carpenter), p. 720 (proportion in the Australian fauna), p. 725 (*Cyllometra* absent from Australia), p. 729 (in key), p. 730 (in key; key to the Australian genera); Crinoids of the Indian Ocean, 1912, p. 6 (exclusively confined to the East Indian region; number of genera and species), p. 11 (represented in the Ceylon region by *Cenometra, Decametra, Colobometra,* and *Oligometra*), p. 12 (represented in the Red Sea region by *Decametra, Colobometra,* and *Oligometra;* in the southeast African region by *Cenometra, Decametra,* and *Oligometra*), p. 22 (distribution in detail; occurs down to 140 fathoms), pp. 46, 49, 51 (in keys), p. 57 (key to the included genera); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 141 (*Epimetra* transferred to this family from the Pontiometridae); Bull. Inst. Océanogr. Monaco, No. 294, 1914, pp. 7, 8 (relation to temperature); Journ. Washington Acad. Sci., vol. 4, 1914, No. 19, pp. 559–563 (correlation of geographic and bathymetrical ranges), No. 20, p. 582 (relation to temperature of habitat); Internat. Rev. gesamt. Hydrobiol. und Hydrographie, 1914, p. 4 (Atlantic and corresponding Indo-Pacific genera); Journ. Washington Acad. Sci., vol. 5, 1915, No. 4, pp. 126–134 (bathymetrical range; phylogenetical and paleontological significance); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed philosophical discussion of the bathymetrical range); Internat. Rev. gesamt. Hydrobiol. und Hydrographie, 1915, p. 223 and following (detailed account of the distribution of the Australian species); Smithsonian Misc. Coll., vol. 65, No. 10, 1915, p. 42 and following (phylogenetical study); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 110 (key to the included genera); Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (represented in the West Indies), p. 26; Smithsonian Misc. Coll., vol. 72, No. 7, 1921, p. 3.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 7, 9, 76, 79, 80, 89, 123, 142.—A. H. Clark, Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39.—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 19, 42, 79, 84, 89, 99, 100, 212, 231, 232, footnote, 235, 280; Vid. Medd. Dansk Nat. Foren., vol. 83, 1927, pp. 23, 26, 27, 28; Ark. Zool., vol. 19, No. 32, 1928, p. 6.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, pp. 641, 643; Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 558.—H. L. Clark, Scientific survey of Porto Rico and the Virgin Islands, vol. 16, pt. 1, 1933, p. 12.—A. H. Clark, Treubia, vol. 14, livr. 2, 1933, p. 208 (*Pontiometra* referred to this family), p. 213.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 22, 23, 25, 27, 43.—Ekman, Zoogeographica, vol. 2, No. 3, 1934, pp. 328, 343 (zoogeographic significance); Tiergeographie des Meeres, 1935, p. 66.—A. H. Clark, Temminckia, vol. 1, 1936, p. 304.——Gilsén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, pp. 2, 14.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, pp. 89, 100, 103.—H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 36.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 12, 15; Lunds Univ. Årsskr., new ser., Avd. 2, vol. 40, No. 8, 1944, p. 54, footnote 1.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 23 (in key), p. 48 (key to the Australian genera).

Pontiometridae A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (includes *Pontiometra*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 649 (referred to the Oligophreata); Mem. Australian Mus., vol. 4, 1911, p. 725 (absent from Australia); Crinoids of the Indian Ocean, 1912, p. 6 (exclusively confined to the East Indian region; number of genera and species), p. 9 (absent from Australia), p. 10 (absent from Japan), p. 11 (occurs on the west coast of the Malay Peninsula), pp. 46, 52 (in keys), p. 57 (key to the included genera); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 141 (not tenable; included genera referred to the Mariametridae except *Epimetra*, which is referred to the Colobometridae).

Pontiomètres A. H. Clark, Bull. Mus. Hist. Nat., Paris, No. 4, 1911, p. 252.

Mariametridae (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 141 (revised; considered as including the genera of Pontiometridae, except *Epimetra*, which is assigned to the Colobometridae).

Diagnosis.—A family of the superfamily Mariametrida in which some or all of the cirrus segments bear dorsally a transverse ridge, rarely two, a proximal and a distal, three spines arranged transversely, or a pair of tubercles or spines, one on each side of the median line.

Geographical range.—From southern Japan, the Bonin and Marshall Islands, southward to Fiji, New Caledonia, Bass Strait between Australia and Tasmania, and Shark Bay, Western Australia, and westward to the eastern coast of Africa from the Red Sea southward to the Cape of Good Hope; from the Bahamas and the Florida Straits to Barbados and Colon.

Bathymetrical range.—From the shore line down to 329 (possibly 731) meters. This family is especially characteristic of shallow water, 9 of the 17 included genera being represented along the shore line, though on the other hand 4, so far as known, are not represented above 100 meters.

Remarks.—Though highly diversified, the cirri of the numerous species in this family always, either throughout or on a greater or lesser proportion of their segments, have dorsal processes consisting of a serrate or tubercular ridge across the segment, or a pair of spines. Sometimes there is a transverse ridge on the basal segments which soon resolves itself into a pair of spines, or the earlier segments may bear a transverse ridge or a pair of spines that soon—sometimes almost immediately—gives place to a single conspicuous dorsal spine, as in the case of *Pontiometra* and *Cotylometra.* In these two genera most of the cirrus segments have single dorsal spines, and unless the basal segments are examined carefully the characteristic feature of the cirri will be overlooked. In *Epimetra* most of the cirri have a fine dorsal carination only; but here the broadly bilobate or forked opposing spine attracts attention at once.

In the other families of the Mariametrida the cirrus segments are dorsally smooth, sharply carinate, or bear more or less strongly developed dorsal spines with their elongated bases lying along the middorsal line. Only in *Amphimetra tessellata* (see part 4a, p. 360) do we occasionally, though very rarely, find some of the earliest dorsal spines paired. This would seem to suggest that the somewhat anomalous genus *Amphimetra* has certain affinities with this family. Its very short brachials ally it more closely, however, with the Himerometridae, while in the very rare instances in which *A. tessellata* has more than 10 arms the IIBr series are always 2, as in the Mariametridae and in most of the multibrachiate species in this family.

The 17 genera included in the family Colobometridae appear at first sight to form a very heterogeneous assemblage, contrasting rather sharply with the homogeneity so characteristic of the families Himerometridae and Mariametridae. Yet when we examine them closely we can see, in spite of the apparent wide dissimilarity of the extremes, a number of features by which they are linked together, and at the same time separated from the genera in neighboring families.

These 17 genera may be segregated into five generic groups. The first group includes the genera *Pontiometra*, *Basilometra*, and *Epimetra*, which agree in having 40 or more arms with extraordinarily narrow division series, stout cirri with at least 40 segments of which the longest are only slightly longer than broad, and one or more of the proximal pinnules greatly elongated. But here the resemblance ends. The three genera differ widely in practically every other feature. In *Basilometra* the IIBr and IVBr and following division series are 4(3+4), and the IIIBr series are 2. In *Pontiometra* all the division series are normally 2, but division series of 4(3+4) occur exceptionally. In *Epimetra* all the division series are 2. *Pontiometra*, with its smooth, enormously elongated and stiffened though not rigid P_1, is unique. The rigid proximal pinnules of *Basilometra* and *Epimetra*, composed of much elongated segments with spinous ends, are structurally the same as the proximal pinnules of the species of *Colobometra*, some of which also possess cirri with a large number of segments. And we must not overlook the fact that the relation of the long and stiff P_1 of *Pontiometra* to the rigid proximal pinnules of *Basilometra* and *Epimetra* is essentially the same as the relation between the long and stiffened P_2 in *Stephanometra indica* and the rigid and spinelike P_2 in the very closely related—perhaps in reality identical—*S. protectus*. In *Pontiometra* all the proximal pinnules are present. In *Basilometra* and in *Epimetra* P_a is always absent, while P_1 and often P_2 and P_b are also absent from the inner arms arising from the IIBr series. This, again, connects these genera with the group of which *Colobometra* and *Cyllometra* are members. Furthermore, the general aspect of *Basilometra*, especially of its pinnules and arms, is much like that of *Colobometra*, while *Epimetra* reminds us equally strongly of *Cyllometra*. The general aspect of *Pontiometra* also is not essentially different from that of *Cyllometra*, in spite of its great size, the very large number of arms, and the very long cirri.

The genus *Cenometra* represents a somewhat isolated type. The highly developed and conspicuous ventrolateral processes on the ossicles of the division series and first two brachials recall the similar processes in the species of *Stephanometra*; comparable, but much smaller, ventrolateral processes occur in *Basilometra*. The greatly enlarged and curved P_2 is suggestive of the proximal pinnules in *Himerometra*, and also in *Cotylometra* and in some species of *Iconometra*. The cirri of *Cenometra*, with their very short segments and paired dorsal processes throughout, are perhaps the most typical of any in the family; but an approach to them is seen in certain species of *Decametra*.

The genus *Cotylometra* also represents an isolated type, though obviously related to the group including *Oligometrides*, and also to the group including *Oligometra*. Its curious short and stout proximal pinnules and long cirri composed of segments most of which bear a single large dorsal spine are quite unique.

The genera *Austrometra*, *Gislénometra*, *Analcidometra*, *Iconometra*, and *Oligometrides* are rather sharply differentiated from the other genera in the family by their stout, stiffened, evenly and rapidly tapering and smooth proximal pinnules, including P_1, and appear by themselves to form a definite group. *Austrometra* from southeastern Australia, *Gislénometra* from southeastern Africa, and *Analcidometra* from the Caribbean Sea and adjacent waters have the third–fifth segments of the genital pinnules markedly broadened to protect the gonads, and include only very small species; they seem to be more closely related to each other than either is to any other genus. A slight broadening of the third–fifth segments of the genital pinnules is sometimes to be seen in some of the species of *Iconometra*, for instance in *I. japonica*, to which they may be assumed to be more distantly related.

Iconometra is obviously closely allied to *Oligometrides*, having the same type of proximal pinnules in all the included species, and the same proximal transverse ridge on the cirrus segments in all the species except *I. japonica* in which the transverse ridge is at first distal, later becoming median, as in *Oligometra*. *Iconometra* represents a sort of generalized type closely approaching *Oligometrides*, with a single species approaching *Oligometra* in its cirri and suggesting *Austrometra* and *Analcidometra* in its genital pinnules. *Iconometra*, occurring from southern Japan to Torres Strait and westward to Flores, has a more restricted range than *Oligometra*, though it has a much broader range than the other four genera of the group—*Oligometrides*, *Austrometra*, *Gislénometra*, and *Analcidometra*. It should be noted that *Iconometra* is the only genus in this group including species with more than 10 arms.

The largest group in the family includes the genera *Petasometra*, *Cyllometra*, *Decametra*, *Colobometra*, *Alisometra*, and *Oligometra*. Typical, or rather extreme, species of these genera, as *Petasometra helianthoides*, *Cyllometra manca*, *Decametra mylitta*, *Colobometra perspinosa*, *Alisometra owstoni*, and *Oligometra carpenteri*, are very different, but each of these genera includes more or less generalized species that converge toward a common type which would fall somewhere within the genus *Decametra.*

Thus *Petasometra,* though quite distinct, is not widely different from *Cyllometra.* The species of *Cyllometra* have normally more than 10 arms; but in some of them 10-armed individuals of full size occur which, as Gislén has pointed out, would fall in the genus *Decametra.*

In most of their characters the smaller species of *Colobometra,* as *C. discolor,* approach those species of *Decametra,* such as *D. chadwicki,* in which the ends of the pinnule segments and the brachials are more or less spiny. These were formerly placed in a special genus, *Prometra,* which was assumed to be intermediate between *Colobometra* and *Decametra;* but it was found quite impossible to draw any sharp line between *Decametra* and *Prometra,* and the latter was suppressed.

Alisometra and *Oligometra* are very close to *Decametra,* although apparently distinct from it.

The genus *Clarkometra* represents a somewhat anomalous type and may for the present be considered as representing a group by itself. It does not seem to me, however, to differ very widely from some of the types included in the genus *Decametra.*

The South African genus *Embryometra* appears to be most nearly related to *Clarkometra,* though the expansion of the third–fifth segments of the genital pinnules suggests a relationship also with the southeastern Australian *Austrometra* and the Caribbean *Analcidometra.*

The 17 species included within the genus *Decametra* as now understood form a very heterogeneous assemblage, many of them having little in common with others beyond numerical agreement in details, and hence general proportions. But a subdivision of the genus is impractical on the basis of our present knowledge.

The family Colobometridae is the largest family of the Mariametrida, including 57 species in its 17 genera. It is also the most diversified. The largest species (*Pontiometra andersoni*) reaches a maximum size only very slightly less than that of the largest species of *Himerometra,* with nearly twice as many arms, while the smallest are smaller than any of the species in the other families.

It has the greatest geographical range of any of the families of the Mariametrida, being the only family represented in southern Australia, southern Africa, and in the Atlantic (Caribbean Sea); but it has not as yet been reported from the Hawaiian Islands where a species of *Lamprometra* (Mariametridae) is found.

Although as in the case of the other families of the Mariametrida the included species are predominantly littoral and sublittoral, the family has a bathymetric range somewhat greater than that of the Mariametridae, and much greater than that of the Himerometridae and Eudiocrinidae. In the Zygometridae one of the genera, *Zygometra,* has a bathymetrical range that is approximately the same as that of the Himerometridae, and therefore much less than that of the Colobometridae; but the other, *Catoptometra,* has a bathymetrical range of nearly 900 meters, greater than the range of all the other genera in the Mariametrida together.

History.—In the *Challenger* report on the comatulids published in 1888 Dr. P. H. Carpenter placed the 10-armed species known to him that are now assigned to the family Colobometridae in the *Milberti* group (*Antedon* [*Oligometra*] *serripinna, A.*

[O.] carpenteri, A. [Colobometra] perspinosa, A. [Decametra] informis, and *A. lovéni [=Colobometra perspinosa]*), with the exception of two (*Antedon bidens [=Oligometrides adeonae]* and *A. [Oligometrides] adeonae*), which he included among the six species that did not seem to fit into any of the groups established by him. The species with more than 10 arms (*Antedon [Cyllometra] manca* and *A. [C.] disciformis*) he placed in the *Palmata* group. In the *Challenger* report he mentioned, as a member of the *Elegans* group, an unnamed new species from the Mergui Archipelago which has the disk extensively plated and a syzygy between the elements of the IBr series.

In 1889 he described this new species under the name of *Antedon [Pontiometra] andersoni* and said that it may be referred for the present to the *Elegans* group, though it differs from the three members of the group which are at present known in certain essential characters. He said that if other species resembling it should eventually be discovered, it may be useful to establish a second group in Series I of the *Antedon*-species, and to call it the *Andersoni* group.

In 1891 Dr. Clemens Hartlaub placed the species of Colobometridae discussed by him in the *Milberti* group (*Antedon [Oligometra] serripinna, A. [Iconometra] japonica,* sp. nov., and *A. [Colobometra] perspinosa*) and in the *Palmata* group (*Antedon [Cyllometra] manca, A. [C.] disciformis, A. [Petasometra] clarae,* and *A. [Cenometra] bella*). *Antedon (Pontiometra) andersoni* he said we are not justified in placing in either the *Palmata* or *Spinifera* groups, although it belongs to Carpenter's third series of *Antedon*—that is, the elements of the IBr series are united by syzygy and the IIBr series are 2.

When I first suggested the family Himerometridae in 1908 the genera of Colobometridae at that time recognized (*Oligometra, Cyllometra,* and *Pontiometra*) were included in it. In my paper on new Recent Indian crinoids, published on June 25, 1909, the family name Colobometridae appeared as a heading under which was the generic name *Cenometra,* followed by the description of two new species, *C. herdmani* and *C. insueta,* and also the generic name *Cyllometra,* followed by the description of the new species *C. soluta.* In a paper on new genera and higher groups of unstalked crinoids published on September 14, 1909, the family Colobometridae was included among the families assigned to the new group Comatulida Oligophreata. In this paper the new family Pontiometridae was established, including the single genus *Pontiometra.*

In a paper on the crinoids of the Zoological Museum at Copenhagen published in 1909 I said:

> The genera *Oligometra, Cyllometra, Colobometra,* and *Cenometra* differ strikingly from the other genera with which I previously associated them in the family Himerometridae; yet they exhibit a remarkable homogeneity among themselves which suggests that their segregation into a separate family would bring out more graphically their systematic relationships. They all agree in having short cirri composed of short subequal joints which bear upon their dorsal side a transverse serrate ridge, which later passes into paired spines or tubercles, and terminally into single spines or tubercles; the second pinnule is always enlarged, and either the first or third or both may be similar to it; the ends of the component joints of the lower pinnules are always more or less prominent, and are fringed with spines or expanded into lateral processes; one or more of the proximal pinnules is stiffened and more or less spine-like, while the middle pinnules usually and the distal sometimes are also more or less stiffened; the first inner pinnule is usually absent in two out of the four genera. *Oligometra* and *Colobometra* are exclusively ten-armed, while the species of *Cyllometra* are some of them ten-armed, while the others are both ten-armed and multibrachiate.

In a paper on crinoids collected by the *Albatross* in the Philippines published on February 15, 1911, the new genus *Epimetra* was described and assigned to the family Pontiometridae, and in the family Colobometridae new species of *Cenometra*, *Colobometra*, *Cyllometra*, and *Oligometra* were recorded. In a revision of the family Mariametridae published by the author on June 30, 1913, the family Pontiometridae was suppressed, the genus *Pontiometra* being referred to the Mariametridae, and the genus *Epimetra* to the Colobometridae. In a paper on the crinoids of the Buitenzorg Museum published in December, 1933, the genus *Pontiometra* was definitely assigned to the family Colobometridae.

KEY TO THE GENERA OF THE FAMILY COLOBOMETRIDAE

*a*¹. More than 50 arms; cirri with more than 46 segments.

*b*¹. P_1 on the outer arms greatly elongated, rather slender and evenly tapering, 22–40 mm. in length with 20–56 segments, several times as long as the short P_2, which is 3.5–7 mm. long with 8 or 9 segments (Part 2, fig. 277, p. 213) and resembles the pinnules following; all the pinnules present; division series all 2 (or occasional ones very exceptionally 4[3+4]); cirri very long and stout with 41–80 (rarely less than 60) segments; 53–120 (seldom less than 60) arms; large and stout, with the arms 105–180 mm. long (from the Philippine and Pelew Islands southward to New Caledonia and the Kei Islands, and westward to the Andaman Islands and the Mergui Archipelago; 0–73 meters)------------------**Pontiometra** (p. 9)

*b*². P_1, P_2, and P_3 similar and of the same length, very stiff and rigid, 23–24 mm. long with 17 or 18 segments; P_4 similar, but shorter; P_a always absent, and P_1, P_2, P_a, and P_b usually absent on the inner arms arising from each IIBr series; IIBr series 4(3+4); IIIBr series 2; following division series 4(3+4); cirri long and moderately stout with 47–49 segments; 80 arms 120 mm. long (Ternate; 2–4 meters)------------------------------**Basilometra** (p. 21)

*a*². Less than 40 arms; not more than 46 cirrus segments.

*b*¹. P_2 very stout, abruptly larger and stiffer than P_1 or P_3, recurved and hornlike, the 11–23 (usually 15–20) segments with produced and spinous distal ends (Part 2, figs. 274, 278, p. 213); cirri stout, strongly curved, with 28-45 segments all of which are much broader than long and bear dorsally paired spines or tubercles; 12–39 arms; size medium or large, the arms 85–140 mm. long (from the Bonin and Philippine Islands southward to northwestern Australia and westward to Ceylon, the Seychelles, and Mauritius; 0–55 [?66] meters)--**Cenometra** (p. 26)

*b*². P_2 not hornlike and abruptly stouter and stiffer than P_1 or P_3.

*c*¹. Third and fourth or third-fifth segments of the genital pinnules broadened to protect the gonads; 10 arms.

*d*¹. Cirrus segments, at least in the outer half of the cirri, with dorsal processes, a transverse ridge, row of spines, or a single spine flanked by a smaller one on each side.

*e*¹. All the cirrus segments except the penultimate bear a dorsal transverse ridge or row of spines.

*f*¹. Cirrus segments with a prominent median transverse ridge appearing in lateral view as a small median spine; P_1 longer and stouter than P_2, which is longer than P_3; all the pinnules present (from Wollongong, New South Wales, to Bass Strait, 102 [?100]–128 meters)-----------------------------------**Austrometra** (p. 52)

*f*². Cirrus segments with the dorsal distal edge thickened and finely spinous; P_2 longer than P_1 or P_3; P_a and usually also other proximal pinnules absent (off the Cape of Good Hope; 293–325 meters)-------------------------**Embryometra** (p. 251)

*c*². The segments in the distal half of the cirri bear dorsally a prominent median spine which at first is flanked on each side by a much smaller spine, but later stands alone; 10 arms 15–60 mm. long (from the Florida Straits and the Bahamas to Barbados and Colon; 5.5–64 meters)--**Analcidometra** (p. 77)

*d*². Cirrus segments smooth dorsally, without dorsal processes; P_1 stout, stiff, and styliform with 6–9 segments; P_2 longer and curved; all the pinnules present (southeastern Africa from East London to Durban; 238 [?146]–567 meters)---------**Gislénometra** (p. 57)

c^2. No broadening or expansion of the genital pinnules, which are slender and evenly tapering.

d^1. P_1 and P_a absent; cirri with 12–19 segments of which the second and third are about as long as broad and the fourth is longer than broad, but the distal are shorter; fifth-seventh or -eighth segments with a low curved transverse ridge, those following with a small simple dorsal tubercle; 10 arms 12–35 mm. long (southwestern Mindanao, Philippines, to the Bonin Islands; 72–80 meters) ---------------------- **Clarkometra (p. 246)**

d^2. P_1 always present, at least on the outer arms of a postradial series; P_a may or may not be present.

e^1. Distal edges of the proximal cirrus segments fringed with spines; cirri with 29–65 segments of which the distal are shorter than the proximal, much broader than long, and bear dorsally prominent paired, or rarely single, dorsal spines; one or more pairs of the proximal pinnules elongated, much stiffened, and composed of elongated segments with very spiny distal ends; segments of all the pinnules and the brachials with spiny distal ends; 10 arms 40–170 mm. long (from the Philippine Islands and Singapore southward to the Solomon Islands, Lord Howe Island, and Port Denison, Queensland, and westward to the Red Sea; 0–106 meters) ------------- **Colobometra (p. 116)**

e^2. Distal edges of all the cirrus segments smooth.

f^1. Cirrus segments beyond the proximal fourth of the cirri with long median unpaired dorsal spines; proximal pinnules short, P_2 the largest, with not more than 13 rather short segments with spinous distal ends; cirri with 24–39 segments; 10 arms 20–80 mm. long (from the Philippine to the Kei and Andaman Islands; 80–113 meters).
Cotylometra (p. 48)

f^2. Outer cirrus segments dorsally with a transverse ridge or paired tubercles or short spines, sometimes with a median tubercle or spine on one or two before the penultimate.

g^1. Cirrus segments with two dorsal transverse ridges, a proximal and a distal, appearing in lateral view as two tubercles or short spines; P_1, P_2, and P_3 are enlarged and stiffened, decreasing in length from P_1, with 9–20 (usually 10–13) segments; the cirri are XVI–XXXV (usually about XX), 17–32 (usually about 20); the 10 arms are 35–70 (usually about 50) mm. long (Aru Islands and northern Australia south to Port Curtis, Queensland, and Cape Jaubert, Western Australia; 0–22 [?27] meters) -- **Oligometrides (p. 61)**

g^2. Cirrus segments dorsally with a single transverse ridge, or transverse row of tubercles or spines, or paired spines, at least in the distal portion of the cirri.

h^1. Cirrus segments dorsally with a low median keel and the distal edge slightly thickened and produced, forming a distal transverse ridge; opposing spine forked; P_a absent throughout; P_1 usually absent on the inner arms of each postradial series; P_1, P_2, and P_3 much elongated, exceedingly slender, with greatly elongated segments, and stiffened; P_1 is shorter, less stout, and less stiff than P_2, with more numerous and shorter segments; P_3 resembles P_2, but is of the same length as P_1; about 40 arms about 50 mm. long (Philippine Islands; 106 meters) ------------------------------ **Epimetra (p. 25)**

h^2. No median keel on the cirrus segments dorsally; opposing spine a simple spine or tubercle.

i^1. P_1 and P_2, and sometimes also P_3, are similar, elongated, stiffened, evenly tapering, and of approximately the same length, composed of segments which beyond the first two are much elongated.

j^1. P_3 much shorter, smaller, and weaker than P_1 and P_2, which are similar and of the same length; cirri with 19–31 segments which are subequal, about twice as broad as long, sometimes slightly longer terminally; 10–31 arms and 85–120 mm. long (from Flores to Amboina and Darwin, Australia, and southward to Shark Bay, Western Australia; 0–40 meters).
Petasometra (p. 105)

j^2. P_3 resembles P_1 and P_2 and is abruptly different from the succeeding pinnules.

*k*¹. P_1, P_2, and P_3 of the same length, composed of segments which have prominent spinous distal ends, at least in the outer portion; cirri with 14–21 segments most of which are about as long as broad; 10 arms 30–60 mm. long (southern Japan to the Philippine Islands; 100–106 meters)------------------------------------ **Alisometra** (p. 112)

*k*². P_2 slightly longer and stouter, or at least stouter, than P_1 or P_2, though all three pinnules are similar, and are entirely smooth; cirri with 15–29 short segments, becoming about as long as broad distally; 10–21 arms 30–100 mm. long (from southern Japan and the Philippine Islands to Torres Strait and westward to Solor Strait and the coast of Annam; 0–146 meters)------------------------------- **Iconometra** (p. 88)

*i*². P_1 shorter, more slender, and more delicate than P_2, and composed of shorter segments.

*j*¹. Usually more than 10 arms, the IIBr and IIIBr series 2; cirri moderately long and slender with the earlier segments usually longer than the distal, which are broader than long (from southern Japan and the Bonin Islands southward to the Philippine, Kei, and Lesser Sunda Islands, and westward to the Persian Gulf; 22 [?15]–329 [?731] meters)----**Cyllometra** (p. 134)

*j*². Never more than 10 arms; cirri short and rather stout with the segments subequal, about as long as broad or broader than long, or slightly longer distally than proximally.

*k*¹. The proximal cirrus segments bear dorsally a transverse ridge which distally becomes a pair of tubercles or small spines, or rarely a single median spine; P_a is absent; P_2 is rounded or rounded prismatic with the distal ends of the segments uniformly spinous or smooth (southern Japan from Sagami Bay to the Korean Straits southward to the Clarence River, New South Wales, and Dirk Hartog Island, Western Australia, and westward to east Africa from the Red Sea southward to Bagamoyo, Tanganyika Territory [opposite Zanzibar]; 0–137 meters]. **Decametra** (p. 170)

*k*². Cirrus segments all with a transverse ridge dorsally except for the penultimate which bears the opposing spine; P_a present (or rarely absent on some arms); P_2 more or less strongly prismatic with the distal portion of the prismatic ridges on each segment produced into more or less broad finlike processes, or with the distal ends of the prismatic ridges bearing tufts of spines (from Fuchow, Province of Fukien, China, and the Philippine Islands southward to the Tonga Islands, New Caledonia, Port Curtis, Queensland, and Baudin Island, Western Australia, and westward to the east coast of Africa from the Red Sea southward to Bagamoyo, Tanganyika Territory; 0–91[?183] meters). **Oligometra** (p. 208)

Genus PONTIOMETRA A. H. Clark

Antedon (part) Lütken, Mus. Godeffroy Cat., vol. 7, 1879, and following authors.

Pontiometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, pp. 346, 354 (diagnosis; genotype, *Antedon andersoni* P. H. Carpenter, 1889); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 247 (same); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (referred to the Himerometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 5 (listed in a revision of the Himerometridae), p. 175 (referred to the Pontiometridae); Proc. U. S. Nat Mus., vol. 39, 1911, p. 542 (compared with *Epimetra*); Crinoids of the Indian Ocean, 1912, p. 11 (occurs in the Mergui Archipelago), p. 22 (distribution in detail), p. 57 (in key), p. 138 (original reference; type); Proc. Biol. Soc. Washington, vol. 26, 1913, pp. 141, 143 (referred to the Mariametridae; synonymy; genotype; range; depth; included species), p. 142 (in key); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 97 (in key; range).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 51 (obliquity of the brachials), pp. 51, 64, 66 (absence of muscular fossae on the radial articular faces), p. 127 (compared with *Glenotremites angelini*), p. 235.—A. H. CLARK, Treubia, vol. 14, livr. 2, 1933, p. 208 (placed in the Colobometridae); Temminckia, vol. 1, 1936, p. 305.

Diagnosis.—A genus of Colobometridae including large or very large and stout species in which the arms are 53–120 (seldom less than 60) in number, 105–180 mm. long; the division series are all 2 (in rare and exceptional cases occasionally 4 [3+4]); the cirri are long and stout with 41–80 (rarely less than 60) segments; and P_1 on the outer arms of each [postradial] series is greatly elongated, rather slender, tapering evenly to a delicate tip, composed of 20–56 segments, and several times as long as the very short P_2, which resembles the pinnules following; all the pinnules are present.

The single species included in this genus has a very characteristic appearance and cannot be confused with any other crinoid.

Geographical range.—From the Philippine and Pelew Islands southward to New Caledonia and the Kei Islands, and westward to the Andaman Islands and the Mergui Archipelago.

Bathymetrical range.—From the shore line down to 73 meters.

History.—The single species included in this genus was first mentioned by Prof. Christian F. Lütken in 1879 under the generic name of *Antedon*.

In my first revision of the old genus *Antedon* published in 1907 the new genus *Pontiometra* was established with *Antedon andersoni* P. H. Carpenter as the only included species. On the creation of the new family Himerometridae by me in 1908 *Pontiometra* was assigned to it, together with *Himerometra*, *Cyllometra*, and *Oligometra*, and it was also referred to the Himerometridae in a revision of that family published in 1909. In a paper published on May 13, 1909, I described a second species of *Pontiometra*, *P. insperatus*, from the Philippine Islands. In a paper published on September 14, 1909, I created the new family Pontiometridae, including *Pontiometra* only. In 1911 I established a new genus, *Epimetra*, including a single new species *E. nympha*, which I assigned to the Pontiometridae and compared with *Pontiometra*. In my memoir on the crinoids of the Indian Ocean published in 1912 I included *Pontiometra*, with *P. andersoni* and *P. insperatus*, and *Epimetra*, with *E. nympha*, in the family Pontiometridae. In a revision of the family Mariametridae published in 1913 the family Pontiometridae was suppressed, *Pontiometra* being replaced in the Mariametridae and *Epimetra* being transferred to the Colobometridae. In my report on the unstalked crinoids of the *Siboga* expedition I similarly included *Pontiometra* in the family Mariametridae.

Dr. Torsten Gislén in 1918 discussed in detail various structural features of this genus.

In my report on the crinoids of the Buitenzorg (Java) Museum published in 1933 I transferred *Pontiometra* to the family Colobometridae.

PONTIOMETRA ANDERSONI (P. H. Carpenter)

PLATE 1, FIGURE 1; PLATE 2, FIGURES 2–5; PLATE 3, FIGURES 6–8

[See also vol. 1, pt 1, figs. 41, 42 (ventral view of central skeletal structures), p. 77; fig. 261 (centrodorsal), p. 255; fig. 341 (cirrus), p. 287; fig. 432 (radial pentagon), p. 349; fig. 475 (radial pentagon), p. 361; pt. 2, figs. 51, 52 (radial pentagon), p. 33; figs. 139, 140 (arm base), p. 83; fig. 194 (lateral view), p. 120; fig. 255 (arm), p. 205; figs. 275–277 (arms and pinnules), p. 213; figs. 724, 725 (disk), p. 346; fig. 798 (ambulacral deposits), p. 372.]

Antedon polypus Lütken, Mus. Godeffroy Cat., vol. 7, 1879 (*nomen nudum*).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 78 (name found with specimens from the Pelew Islands).—A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 117 (original reference to the name; identity); Crinoids of the Indian Ocean, 1912, p. 138 (original reference to the name; identity).

Antedon sp. Bell, Proc. Zool. Soc. London, 1887, p. 140 (Andaman Islands).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 32 (identity).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 265 (anomalous species from Mergui).

Antedon andersoni Bell, Proc. Zool. Soc. London, 1888, p. 389, footnote 5 (collected by Dr. Anderson at Mergui).—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 304 (specific formula), p. 306 (detailed description; King Island, Mergui Archipelago, sublittoral; *Elegans* group; discussion and comparisons), pl. 26, figs. 1–5; pl. 27, fig. 8.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 78 (Pelew Islands; detailed descriptions of the specimens), p. 113 (in Göttingen Mus.), pl. 3, fig. 36.—Koehler, Rev. Suisse Zool., vol. 3, 1895, p. 287 (Bay of Amboina; notes).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 457 (reference to satisfactory description); Crinoids of the Indian Ocean, 1912, pp. 36, 37 (identity of previous records).

Pontiometra andersoni A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 355 (listed); vol. 52, pt. 2, 1908, p. 212 (*Albatross* station 5146); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 5 (listed), p. 13 (closely related to *Antedon finschii*); Vid. Medd. Naturh. Foren. København, 1909, p. 165 (synonymy; includes *polypus;* Singapore; descriptions of specimens), p. 167 (Philippine Islands; a specimen with about 100 arms), p. 193 (collected at Singapore by Svend Gad); Proc. U. S. Nat. Mus., vol. 39, 1911, pp. 542, 543 (compared with *Epimetra nympha*); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 252 (New Caledonia; description); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 21 (localities); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 397 (Singapore); Crinoids of the Indian Ocean, 1912, p. 22 (distribution in detail), pp. 32, 36, 37 (identity of previous records), p. 138 (synonymy; records).—Reichensperger, Abh. Senck. Naturf. Ges., vol. 35, No. 1, 1913, p. 83 (Kei Islands), p. 103 (details of the locality; characters).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 144 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 98 (references; notes; station 310); p. 276 (listed).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 42 (brachial angles), pp. 46, 51 (obliquity of joint faces), p. 53 (axillary angle), p. 78 (syzygies), p. 88 (articulations), p. 89 (articulation in the IBr series), p. 99 (pinnule articulations), figs. 34, 35, p. 52, fig. 71, p. 75 (syzygial face), fig. 100, p. 87 (synarthrial face), figs. 151–153, p. 98 (pinnule articulations).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 640 (80 miles NW. of Penang; 40 fms.); Treubia, vol. 14, livr. 2, 1933, p. 213 (NW. of Rembang; Java Sea); Proc. Biol. Soc. Washington, vol. 47, 1934, p. 11 (New Harbour; Singapore).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 33.—A. H. Clark, Temminckia, vol. 1, 1936, p. 304 (Amboina; notes).—Gislén, Kungl. Fysiogr. Sällsk. Lund Förh. vol. 7, No. 1, 1936, p. 4 (French Indo-China), p. 6 (range), p. 12 (Pulo Condor).

Pontiometra insperatus A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 397 (description; *Albatross* station 5145); Crinoids of the Indian Ocean, 1912, p. 138 (synonymy; locality); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 144 (listed).

Pontiometra polypus A. H. Clark, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 144 (listed).

Description.—The centrodorsal is large and thick with swollen sides and a rather deeply sunken dorsal pole. The cirrus sockets are arranged in three rows.

The cirri are about L, about 80, and are up to 87 mm. long. They are stout, and after the proximal third become increasingly compressed laterally. Their component segments are fairly similar. On the third segment the distal dorsal edge begins to stand out as a strong transverse ridge beset with fine spines. Farther on in place of the transverse ridge there are two spines placed side by side, and finally toward the end of the cirri each segment bears a stout spine which is directed distally.

The radials are visible only in the interradial angles of the calyx. The IBr$_1$ are entirely free laterally. The IBr_2 (axillaries) are pentagonal, and about 4 mm. long; their free sides are longer than those of the IBr_1. All the division series are composed of 2 rather elongated ossicles of which the first is almost as long as the axillary, and the latter has a very wide distal angle. The two elements of the IIBr series together measure about 6 mm. There are present low and feebly developed synarthrial tubercles on the articulations between the elements of the division series. The two ossicles immediately following each axillary are laterally united interiorly. The postradial series divide 5, or occasionally 6, times. They are rather widely separated, but they come again into contact at the base of the arms. The spaces between the division series are filled by the dorsal surface of the very large disk.

There are about 90 arms 175 mm. long. The arms are entirely smooth, and in their proximal third, especially at the base, they are strongly compressed laterally, this lateral compression decreasing distally. The first and second brachials are narrow and long, and the first syzygial pair (composed of brachials 3+4) is still longer. The following 8 or 9 brachials are rectangular, and are only slightly longer than broad. The brachials succeeding become rapidly shorter and are bluntly wedge-shaped. In the distal half of the arms the brachials are very short and more discoidal.

The first syzygy is between brachials 3+4, the second is at about the fiftieth brachial, and the distal intersyzygial interval is from 8 to 13 muscular articulations.

P_1 on the outer arms of the group borne by each IIIBr series is very long, while the same pinnule on the other arms is short. Each postradial series therefore shows eight long P_1 which measure 35–40 mm. in length and are composed of about 50 elongated segments. P_1 on the inner arms of each IIIBr series is only 8 mm. long. P_a measures about 6 mm. in length, and P_2 7 mm. The pinnules of the three following pairs are of approximately the same size, and are 5–6 mm. long. From the sixth pair onward the pinnules gradually increase in length, finally reaching 16 mm.

The disk is 49 mm. in diameter, and is plated and strongly incised. The borders of the ambulacral grooves are much swollen, and in the vicinity of the mouth completely arch over the latter. The anal tube is long. The sacculi on the pinnules are large and thickly set.

The color is dark brown.

Notes.—The preceding description is adapted from Hartlaub's description of three specimens from the Pelew Islands acquired from the Godeffroy Museum which he examined in the Hamburg Museum, from which one was later sent to Göttingen.

The specimen from Cebu in the Hamburg Museum is of medium size.

The specimen from *Albatross* station 5145 was described as a new species under the name of *Pontiometra insperatus* in the following terms:

The centrodorsal is hemispherical with the dorsal pole small and slightly convex. The cirrus sockets are arranged roughly in three more or less crowded alternating rows.

The cirri are XX, 41–52, 30 mm. long, stout, but tapering in the distal half and becoming comparatively slender at the tip The first segment is three times as broad as long, the second and third are twice as broad as long, and those following gradually increase in length to about the seventh which is about one-third again as broad as long. The next three or four segments are similar, those succeeding gradually decreasing in length so that the segments in the distal third of the cirri are uniformly twice as broad as long. The sixth-eighth and following segments have the distal dorsal edge everted in the shape of an open V-shaped ridge, which is composed of an apical round tubercle and two lateral more or less elongate tubercles. Distally this ridge gradually becomes less and less V-shaped and is composed of four or five tubercles, the apical tubercle, however, remaining in the same position and therefore occupying a position below the center of the now almost straight tubercular ridge. As the segments decrease in length distally the apical tubercle gradually disappears, and the transverse ridge moves gradually to a median position. On becoming median it at first has usually four tubercles, this number being later reduced to three, while beginning on about the fifteenth from the end there are only two, the last three or four segments before the penultimate bearing only a single median tubercle. The opposing spine is comparatively large, arising from the entire dorsal surface of the segment, with the apex subterminal; it is equal to about half the width of the penultimate segment in height. The terminal claw is somewhat longer than the penultimate segment and is rather stout and strongly curved.

The radials are short in the midradial line but extend far up into the angles of the calyx, reaching the disk and separating the bases of the IBr_1. The IBr, are slightly trapezoidal, about twice as broad basally as long, and are well rounded dorsally and very widely separated laterally. The IBr_2 (axillaries) are pentagonal, about as long as broad. The IIBr series are 2, only one being present.

The 11 arms are very widely separated; all are broken off at the syzygy between brachials 3+4. The first brachials are slightly wedge-shaped, half again as broad as long, interiorly united for the proximal half or two-thirds, their inner borders thence diverging distally at approximately a right angle. The second brachials are about as long as broad and approximately rectangular. The third brachials (the hypozygals of the first syzygial pair) are oblong and three times as broad as long.

P_1 is slender, evenly tapering, 15 mm. long, and composed of 20–25 segments of which the first is twice as broad as long, the second and third about as long as broad, and those following are about twice as long as broad, becoming shorter terminally.

The color in alcohol is purplish brown.

The specimen from *Albatross* station 5146 is a particularly fine example with about 120 arms.

The specimen from New Caledonia is a beautiful representative of the species with 64 arms. The cirri are XXXII, 59–74; the dorsal processes begin on the twenty-fifth segment. P_1 has 46–56 segments. P_2 and the pinnules following have 8 or 9 segments and are very short.

The specimen from Little Kei Island described by Reichensperger is very large. The centrodorsal is thick with the dorsal pole concave; the cirrus sockets are arranged in three rows.

The cirri are over LX, 60–70, from 60 to 70 mm. long. In the distal half of the cirri the segments are carinate or feebly spiny.

The postradial series divide occasionally six times. The IBr axillary is only slightly broader than long, and is somewhat constricted centrally. The division series are 2, the distal rarely 4(3+4). The axillaries are almost always centrally constricted.

The 104 arms are up to 160 mm. long, and consist of 180–190 brachials beyond the outermost axillary. Like the division series, the arms are smoothly rounded dorsally. The first 10 brachials are almost square, those following to about the fifteenth are broader than long, the succeeding are very bluntly wedge-shaped, and the distal are more discoidal.

The first syzygy is between brachials 3+4, the second is at about the fortieth brachial, and those following occur at intervals of 11–15 muscular articulations.

P_1 on the outer arms is by far the longest pinnule; it is slender and flagellate, about 35 mm. long with 41–46 segments. On the inner arms P_1 reaches at the most from one-fourth to one-third its length on the outer arms. P_2 is very short, only about 4 mm. long. The pinnules following remain of about the same length, later slowly increasing up to 23 mm. in the distal portion of the arms.

The diameter of the disk is almost 50 mm. The color is dark red-brown.

Professor Koehler said that the specimen from the Bay of Amboina studied by him had the arms 170–180 mm. long. The color was deep purple, almost black. The specimen agreed absolutely with Hartlaub's description. It showed especially the considerable differences between the pinnules on the outermost and on the inner arms of each IIIBr series as described by Hartlaub.

The specimen from the pier at Amboina is a magnificent example of the species with 20+16+18+17+18=89 arms.

The specimen collected by the *Willebrord Snellius* at Amboina on September 17, 1930, has 15+18+15+12+14=74 arms 180 mm. long. The cirri are 90–100 mm. long with 75–79 segments.

The specimen from *Siboga* station 310 is medium sized, with 53 arms about 140 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 111 consists of a centrodorsal and arm bases, and a detached visceral mass; the cirri are XXXVIII, 63–70, up to 70 mm. in length.

In one of the specimens from Singapore the cirri are XXXVI, 75–78 (the undeveloped cirri with 68–70 segments), from 70 to 80 mm. long. The first cirrus segment is about three times as broad as long, and those following slowly increase in length to the thirteenth or fourteenth, which is about as long as broad. The succeeding segments are similar, or become very slightly longer than broad. Somewhere between the twenty-sixth and twenty-ninth (rarely so early as the twenty-third) there is a segment about as long as broad mostly dark with a dull surface like the segments preceding, but becoming lighter and more polished distally, especially on the dorsal side, like the segments succeeding. The following segments are at first very slightly broader than long, then gradually become shorter, the majority of the distal segments being about twice as broad as long. The transition segment and those following bear distally on the dorsal end a transverse ridge which is furnished with usually 6 rounded teeth; distally this ridge gradually becomes narrower, after about 20 segments becoming merely a pair of teeth, and after about eight segments more a single dorsal spine. With the decrease in width of the transverse ridge the dorsal surface of the segments becomes more and more carinate, at first only in the distal portion, but gradually more and more of the surface is involved so that, viewed laterally, there appears to be a series of dorsal spines which at first rise sharply from the distal end only, but later progressively involve more and more of the dorsal surface, at the same time taking on a rounded character dorsally. The opposing spine is terminally situated, erect or directed slightly forward, arising from the whole surface of the penultimate segment, and in height equal to about half the width of that segment. The terminal claw is considerably longer than the penultimate segment and is stout and slightly curved.

The radials are much produced anteriorly in the interradial angles of the calyx, entirely separating the bases of the IBr_1. The division series are deep, strongly and smoothly rounded dorsally, and very widely separated. The first segments following the earlier axillaries are interiorly united for about the proximal half, the distal halves of their inner borders diverging widely. After the succeeding axillaries progressively more and more of the inner edge of the ossicles is involved, until in the free undivided arms we usually find the first brachials entirely united interiorly. The division series and arms are rather strongly compressed laterally.

The 72 arms are 135 mm. long. The first brachials are broader than long, the second are about as long as broad, and the first syzygial pair (composed of brachials 3+4) is oblong and longer than broad. The brachials following are oblong and nearly twice as broad as long for the first seven or eight, then triangular and over twice as broad as long, after the proximal third of the arm becoming wedge-shaped and very short.

P_1 is 22 mm. long, not particularly stout, though much the stoutest pinnule on the arm, evenly tapering and composed of 33 segments of which the first is short, the third is about as long as broad, and those following are about half again, later nearly twice, as long as broad. P_2 is 3.5 mm. long, delicate and weak, evenly tapering, and is composed of about 8 segments. The next four pinnules are similar and those succeeding gradually increase in length, the distal reaching 12 mm. The distal pinnules have 25 or 26 segments of which the first two are short and rather broad and the remainder are about half again as long as broad, becoming twice as long as broad in the terminal portion. On the outermost arm of each IIIBr series P_1 is much larger than the corresponding pinnule on the inner arms, or than P_a on the same arms.

The disk is very deeply incised, with a very long and slender anal tube.

The color in alcohol is deep violet, the division series with perceptibly darker lateral lines. The alcohol itself is stained light red.

Another specimen from Singapore has 70 arms about 120 mm. long and the cirri 60–70 mm. long.

Of the three other specimens from Singapore one has 60 arms 105 mm. long. The outermost branches from the IIBr series have, as usual in this species, one more axillary than the inner. The cirri are XXIII, 45–60, from 50 to 60 mm. long. The anal tube is 15 mm. high. The color is nearly white with the perisome light brownish gray; the division series show traces of slightly darker lateral lines. Another has 65 arms 130 mm. long. The cirri are XL, about 70, from 60 to 70 mm. long. P_1 is from 20 to 22 mm. long and is composed of 30 segments. P_2 is 4 mm. long with 8 or 9 segments. The anal tube reaches a height of 15 mm. above the disk. The color is deep violet. The third specimen consists of the calyx, centrodorsal, and arm bases of a medium-sized example. The disk has been lost and is just beginning to regenerate, having reached approximately the stage figured by Bell in the type specimen of *Zygometra microdiscus*.

The specimen from King Island, Mergui Archipelago, was thus described by Dr. P. H. Carpenter:

The centrodorsal is a thick disk.

The cirri are about XL, 60–70, reaching 60 mm. in length. The cirrus segments are tolerably uniform, and those in the distal half of the cirri bear sharp dorsal spines.

The radials are partially visible. The IBr_1 and IBr_2 (axillaries) are narrow and strongly convex and are united by syzygy. The postradial series are quite free laterally and divide four or five times. Each division series consists of two articulated ossicles of which the first is nearly square and the axillary is pentagonal, often as long as or longer than broad. All the ossicles of the division series are relatively deep and narrow, with a strongly rounded dorsal surface.

The arms are very numerous, 15 or 18 to the ray (75–90 in number), 175 mm. in length. The brachials are laterally compressed; the lower are oblong, and their successors are more unequally quadrate.

The first syzygy is between brachials 3+4, with others following at very uncertain intervals of from 6 to 14 muscular articulations; but they are apparently altogether absent from some arms.

P_1 is slender and tapering, consisting of 35 or more elongated segments and reaching nearly 25 mm. in length. The next few brachials bear quite short pinnules with only some 6 or 8 segments, and their successors increase slowly in length, but never become specially long.

The disk is 25 mm. in diameter and is much incised. It is not regularly plated, though the integument is very dense and tough. Sacculi are very abundant on the pinnules.

The color is very dark, almost black—probably deep purple in life—with lighter patches on the arms.

Carpenter's material from King Island consisted of one specimen and a detached disk.

The specimen from Padaw, Mergui Archipelago, is a broken example with about 85 arms.

Localities.—Cebu, Philippines [A. H. Clark, 1912] (1, H. M.).

Albatross station 5145; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 16° E., 0.85 mile distant (lat. 6°04′30″ N., long. 120°59′30″ E.); 42 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1909, 1912] (1, U. S. N. M., 25468).

Albatross station 5146; Sulu (Jolo) Archipelago, in the vicinity of Siasi; Sulade Island (E.) bearing N. 18° W., 3.4 miles distant (lat. 5°46′40″ N., long. 120°48′50″ E.); 44 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908, 1909, 1911, 1912] (1, U. S. N. M., 35222).

Sulu (Jolo), Philippines [A. H. Clark, 1912] (arm fragments, H. M.).

Pulo Condor, Cochin China; 10–15 meters; Dr. C. Dawydoff [Gislén, 1936].

Pelew Islands [Hartlaub, 1891; A. H. Clark, 1908, 1912] (1, H. M.).

New Caledonia [A. H. Clark, 1911, 1912] (1, P. M.).

Little Kei (or Roa), Kei Islands; Dr. H. Merton [Reichensperger, 1913].

Bay of Amboina; MM. Bedot and Pictet [Koehler, 1895].

Amboina; pier; 0–2 meters; *Willebrord Snellius*, May 6, 1930 [A. H. Clark, 1936] (1, L. M.).

Amboina; *Willebrord Snellius*, September 17, 1930 [A. H. Clark, 1936] (1, L. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; about 2 meters; stony bottom; February 9, 1922 (1).

Siboga station 310; eastern coast of Sumbava (lat. 8°30′00″ S., long. 119°07′30″ E.); 73 meters; sand with a few pieces of dead coral; February 12, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 111; Java Sea; 27 meters; sand and shells; August 7, 1922 (1, C. M.).

Singapore; Prof. E. von Martens [A. H. Clark, 1912] (2 cirri and a visceral mass, Berl. M., 5351, 5372).

Singapore; Svend Gad [A. H. Clark, 1909, 1912] (5, U. S. N. M., 36264; C. M.).

Singapore, 1899 [A. H. Clark, 1934] (1, Raffles Mus.).

New Harbour, Singapore; 15 meters; July 31, 1899 [A. H. Clark, 1934] (1, Raffles Mus.).

Eighty miles northwest of Penang; 73 meters; cable repair ship *Patrol*, Eastern and Associated Telegraph Co., through Colonel Grant, I. M. S.; taken in May, 1923, from a cable laid two years previously [A. H. Clark, 1929] (visceral mass, B. M.).

Northwest of Rembang, Java (lat. 5°39′ S., long. 111°19′ E.); October 19, 1908 [A. H. Clark, 1933] (3, Buitenzorg Mus.).

Java Sea, north-northeast of Indramayu Point, Java (lat. 4°55′ S., long. 108°56′ E.); October 23, 1907 [A. H. Clark, 1933] (1, Buitenzorg Mus.).

Andaman Islands; Colonel Cadell, V. C. [Bell, 1887; A. H. Clark, 1912].

King Island, Mergui Archipelago; Dr. John Anderson [Bell, 1888; P. H. Carpenter, 1889; A. H. Clark, 1907, 1908, 1912].

Padaw, Mergui Archipelago [A. H. Clark, 1912] (1, I. M.).

Geographical range.—From the Philippines and the Pelew Islands southward to New Caledonia and the Kei Islands, and westward to the Andaman Islands and the Mergui Archipelago.

Bathymetrical range.—From the shore line down to 73 meters.

History.—The first mention of this species is found in the Catalogue of the Godeffroy Museum at Hamburg published in 1879, which includes the name *Antedon polypus* Lütken without any indication of the form to which it refers.

The species was next mentioned in 1887 as *Antedon* sp. by Prof. F. Jeffrey Bell in a paper on a collection of echinoderms from the Andaman Islands made by Col. Thomas Cadell, V. C., who at the time was in charge of the islands. Professor Bell said that this *Antedon* was represented also in the collection made in the Mergui Archipelago by Dr. John Anderson and that Dr. Herbert Carpenter had promised to discuss its relations to *A. palmata* in the report on the crinoids of Mergui which he had in preparation.

In a list of the echinoderms of the Bay of Bengal published in 1888 Professor Bell in a footnote said that *Antedon andersoni* (*nomen nudum*) had been collected by Dr. Anderson at Mergui.

In the *Challenger* report on the comatulids published in 1888 Dr. P. H. Carpenter said that he had found the same extensive plating on the disk characteristic of *Antedon* (*Zygometra*) *elegans* in another species from Mergui which has a syzygy between the elements of the IBr series and the postradial series dividing four times, each division series being of 2 ossicles. This refers to the present species, although Carpenter did not mention it by name.

In a paper on the comatulids of the Mergui Archipelago collected by Dr. John Anderson, Superintendent of the Indian Museum, Calcutta, published in 1889, Carpenter described and figured *Antedon andersoni.*

Carpenter said that this is a fine species that may be referred for the present to the *Elegans* group, though it differs from the three members of the group (*Zygometra microdiscus, Z. elegans,* and *Z. comata*) which are at present known in certain essential characters. If other species resembling it should eventually be discovered, he said, it may be useful to establish a second group in Series I of the *Antedon* species, and to call it the *Andersoni* group. He noted that the three existing members of the *Elegans* group all have the IIBr series 4(3+4), and have a well-plated disk, whereas in *Antedon andersoni* the IIBr series are 2, and the disk has nothing like the large plates covering the interpalmar areas that occur in *Antedon multiradiata, A. elegans,* and *A. microdiscus.* But on the other hand it is very tough and leathery, and the ambulacral grooves are more or less completely closed by the approximation of their sides. This is also visible in the lower parts of the brachial ambulacra, which are often entirely closed by an irregular alternation of processes from opposite sides. There is, however, no indication either of side plates or of covering plates on the pinnule ambulacra, which are of the usual character. But isolated portions of the brachial ambulacra effervesce strongly with acid, and the perisome would therefore seem to contain a considerable amount of diffused limestone particles which are not concentrated into definite spicules or plates as in most other crinoids. This would partly account for the hardness and leathery character of the perisome on the disk.

Carpenter remarked that the condition of the disk and the bidistichate rays (the occurrence of IIBr series of 2 instead of 4[3+4]) are the essential points of difference between *A. andersoni* and the three existing members of the *Elegans* group. It resembles but surpasses them all in the great length of its cirri, and also in the length of the first pinnule; but this pinnule is on the second brachial and not on the $IIBr_1$ as in the *Elegans* group, while its successors do not decrease slowly in length, but exhibit a sudden and remarkable diminution in size, that of the third brachial consisting of but half a dozen small segments. The following pinnules increase gradually in length, but never reach any considerable size.

Carpenter noted that another characteristic feature of *A. andersoni* is the convex shape of the joints forming the rays and their subdivisions, and also the lateral compression of the brachials. Owing, however, to the rays being so widely separated there is no trace whatever of the lateral flattening of their bases which is so characteristic of the *Basicurva, Spinifera,* and *Granulifera* groups (that is, the species of Charitometridae and Thalassometridae) and occasionally shows itself also in *A. elegans.* He said that this is very marked in the fossil *Antedon costata* for which Walther had recently proposed to restore the generic name *Solanocrinus,* originally applied to this species by Goldfuss; for he believes that the fossil species which he refers to this genus are devoid of the syzygies in the arms which occur more or less frequently in other crinoids. He attempts to establish some other characters which would distinguish *Solanocrinus* from *Antedon*—an attempt which, Carpenter said, he would scarcely have made had he been better acquainted both with the literature of the subject and with the condition of many recent species of *Antedon*, as he (Carpenter) had pointed out elsewhere; and the only character, therefore, on which he can possibly rely for the separation of *Solanocrinus* from *Antedon* is the presence of syzygies in the arms of the latter and their absence in those of the former genus. But the material on which he has founded this generalization seems to be altogether insufficient. Few, if any, of his very limited number of specimens have as many as forty brachials remaining, and these are rarely in a satisfactory state of preservation, so that it is somewhat rash to speak positively about the total absence of syzygies in the arms of *Solanocrinus*. Carpenter said that, in fact, he had shown reason to believe that syzygies are present even in some of the arms which are figured and described by Walther as being entirely devoid of them.

Carpenter remarked that, on the other hand, *Antedon andersoni* is remarkable for the rarity of the syzygies in the arms. It was a long time before he could discover any at all, except that between brachials 3+4. In fact, he did not succeed in finding any in some arms, while in others they are often separated by intervals of ten or a dozen segments. In *Antedon elegans* (=*Zygometra elegans*) and *A. multiradiata* (=*Z. microdiscus*) the second syzygy may not be until the fortieth or even the sixtieth brachial, and the intervals between its successors may be 15 or 20 joints (that is, 16 or 21 muscular articulations). Were these species in the fossil state, therefore, with only the lowest portions of the arms preserved, and that but badly, it would be easy to overlook the syzygy in the third brachial (that is, between brachials 3+4) and to infer that none were present in the arms at all, though such an inference would not be in accordance with the facts of the case. Carpenter could not but suspect, therefore, that Walther's attempt to establish the absence of syzygies as a diagnostic character of *Solanocrinus* was due partly to a generalization on imperfect material, and partly to an insufficient acquaintance with the variations in the distribution of the syzygies among Recent comatulids.

Carpenter said that any member of the *Elegans* group preserved in the fossil state would made a fairly good *Solanocrinus*, for each species has a relatively large centrodorsal bearing a good number of cirri, with few syzygies between the brachials, but one between the elements of the IBr series. This latter condition certainly occurs in *Solanocrinus costatus*, and probably also in *S. imperialis* and *S. gracilis*, as he has explained elsewhere; and Carpenter was inclined to regard these last mentioned species as the ancestral forms of the existing members of the *Elegans* group. On the other hand, he said, *Antedon scrobiculata* and *A. aspera*, with a bifascial articulation (that is, synarthry) between the elements of the IBr series, were the Jurassic representatives of the majority of the Recent species of *Antedon* in which the two elements of the IBr series are united by synarthry.

In 1891 Dr. Clemens Hartlaub described in detail three specimens from the Pelew Islands which he found in the Hamburg Museum labeled *Antedon polypus* Lütken. One of these was later transferred to the Göttingen Museum. Hartlaub said that a study of the last mentioned specimen showed that the articulation between the elements of the IBr series is not a syzygy; this articulation not only does not differ externally in any way from the other articulations, but the axillary is rather freely movable on the IBr_1. This species, therefore, can not be assigned to the *Elegans* group as was done by Carpenter as a result of the erroneous interpretation of the character of this articulation. Hartlaub said it was remarkable that Carpenter did not notice a feature that is very striking in the specimen before him, namely that the second brachial of the outermost arms arising from each IIIBr series carries a much longer pinnule than the second brachial of the inner arms, so that each postradial series shows eight very long pinnules. That this feature was not noticed by Carpenter was due to the fact, so Carpenter informed Hartlaub by letter, that the type specimen was not well preserved and most of the lower pinnules were broken.

Hartlaub's description of *Antedon andersoni* follows his discussion of species belonging to the *Palmata* and *Spinifera* groups. He said that *andersoni* can not be included in either of these groups, although it belongs to Carpenter's Series III.

In 1895 Prof. René Koehler recorded a specimen from the Bay of Amboina that had been collected by Maurice Bedot and C. Pictet. He remarked that Carpenter had placed this species in the *Elegans* group, but Hartlaub believed it could not be placed there but instead should form a special group in the genus *Antedon.* He said that he agreed absolutely with Hartlaub.

In my first revision of the old genus *Antedon* published in 1907 *Antedon andersoni* was made the type of the new genus *Pontiometra.* In a paper including all the names that had been used for Recent crinoids published in August 1908, I said that the original description of this species was based on a much mutilated individual and in addition contained some misleading statements. The first good description was said to be that by Hartlaub. In December 1908, a specimen was recorded from *Albatross* station 5146 in the Philippines.

In my revision of the families Thalassometridae and Himerometridae published in January 1909, *Pontiometra andersoni* was listed, and *Antedon* (*Oxymetra*) *finschii* was said to appear to be most closely related to this species. In May 1909 a new species, *Pontiometra insperatus,* was described from *Albatross* station 5145 in the Philippines. In a paper on the crinoids of the Copenhagen Museum published in 1909 five specimens were recorded from Singapore, and notes were given on them. The specimen collected by the *Albatross* in the Philippines (at station 5146) was said to have about 120 arms.

In a paper on the crinoids of the Paris Museum published in 1911 I recorded and gave notes on a specimen from New Caledonia, and in another paper published in the same year I compared the division series and arms of this species with those of *Epimetra nympha.* In a paper on the crinoids of the Hamburg Museum published on November 7, 1912, I recorded a specimen from the Pelew Islands, which was one of those previously recorded by Hartlaub, one from Cebu, and some arm fragments from Jolo (Sulu). In a paper on the crinoids of the Berlin Museum published on November 20 of the same year I recorded fragments from Singapore. In a memoir on the crinoids of the Indian Ocean published in 1912 a specimen was recorded from Padaw in the Mergui Archipelago, and the synonymy of the species was given together with a list of the localities from which it is known.

In 1913 Dr. August Reichensperger recorded and described a very large specimen which had been collected by Dr. H. Merton at Little Kei, or Roa, Island.

In my report on the Recent crinoids of the *Siboga* expedition published in 1918 I recorded and gave notes upon a specimen from station 310, and also gave the synonymy of the species.

Dr. Torsten Gislén in 1924 described in detail many of the structural details of this form.

This species was recorded by me in 1929 from off Penang, in 1933 from two localities near Java, and in 1934 from New Harbour and Singapore.

Dr. Torsten Gislén recorded two specimens from Pulo Condor, Cochin China, in 1936.

Genus BASILOMETRA A. H. Clark

Basilometra A. H. Clark, Temminckia, vol. 1, 1936, p. 304 (diagnosis; genotype *B. boschmai*, new species).

Rhadinometra Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, Aug. 11, 1936, p. 2 (new genus from French Indo-China), p. 15 (genotype *R. dawydovi*, new species).

Diagnosis.—A genus of Colobometridae including large, but slender, species in which the arms are 80 in number, 120 mm. long; the IIBr series are 4 (3+4), the IIIBr series are 2, and the outer division series are 4 (3+4), all with occasional exceptions; the cirri are long and moderately stout, 35 mm. long with 47–49 segments; the dorsal processes on the cirrus segments are so slight that the cirri appear practically smooth in lateral view; P_1, P_2, and P_3 are similar and of the same length, very stiff and rigid, 23–24 mm. in length with 17 or 18 segments; P_4 is similar, but shorter; the pinnules on the division series are shorter and less rigid than the proximal arm pinnules; P_a is always absent; P_1, P_2, P_a, and P_b are usually absent on the inner arms on each IIBr series.

The single species in this genus has a very characteristic facies, suggesting a slender armed species of *Heterometra* with the pinnulation of a large species of *Colobometra*.

Geographical range.—From Ternate northward to Cochin China and Cambodia.

Bathymetrical range.—From the shore line down to 15 meters.

Remarks.—In its very slender division series and arms, in the character and interrelationships of its proximal pinnules, in the absence of certain proximal pinnules, in the proportions of its cirri, and in the slight development of dorsal processes on the segments of the latter *Basilometra* bears a rather striking resemblance to the very much smaller and more delicate *Epimetra*, though in the latter all the division series are 2, and the cirrus segments bear dorsally a delicate median ridge, which may be paired.

It is probable that *Basilometra* and *Epimetra* are rather closely related, and that both are somewhat more distantly, though still closely, related to *Pontiometra*.

Gislén said that because of the combination of curious cirri, mode of arm ramification, slender arm bases, defective pinnulation, and characteristic proximal pinnules this type is clearly distinguished from every other comatulid. In regard to arm ramification it comes nearest to *Petasometra*, from which it differs in the following particulars: The centrodorsal is subconical instead of discoidal; the cirri are very numerous, with numerous segments; the spinosity of the cirrus segments is unique; division series are present up to IVBr series; the IIIBr series are usually 2; the arms are slender, and the arm bases widely separated; the brachials are long, and the distal intersyzygial interval is 3 muscular articulations; the pinnulation of the inner arms is very defective; and the proximal pinnules following P_P have spinous distal ends, suggesting those in *Heterometra*.

History.—The genus *Basilometra* was originally described by me in February 1936 to include the single species *B. boschmai.* On August 11, 1936, Dr. Torsten Gislén again described the same type under the new generic name *Rhadinometra*, with the single species *R. dawydovi.*

BASILOMETRA BOSCHMAI A. H. Clark

Plate 5, Figures 16–19

Basilometra boschmai A. H. Clark, Temminckia, vol. 1, 1936, p. 295 (listed), p. 305 (description; Ternate, 2–4 meters), pl. 7, figs. 1–4.

Rhadinometra dawydovi Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, Aug. 11, 1936, p. 5 (French Indo-China), p. 6 (range), p. 15 (Pulo Condor, Cochin China; Réam, Cambodja; description and discussion), figs. 5, 6, p. 15, fig. 7, p. 18.

Description.—The centrodorsal is thick discoidal with the slightly concave dorsal pole about 4 mm. in diameter. The cirrus sockets are arranged in three closely crowded irregular marginal rows.

The cirri are XXVI, 47–49, moderately stout and uniform, 35 mm. in length. The first segment is short; those following increase very slowly in length to the eighth-twelfth, which are about one-third again as broad as long, and those succeeding decrease very slowly and gradually so that those in the terminal fourth of the cirri are about twice as broad as long. The longer proximal segments are very slightly constricted centrally. The eighth and following segments have the distal dorsal edge thickened and provided with an even row of 4–6 rounded tubercles. This row of tubercles gradually becomes bowed proximally and at about the beginning of the terminal quarter of the cirri becomes V-shaped with the tubercles on either side of the apex of the V more or less broadened and fused. After three or four segments this V resolves itself into a pair of small tubercles situated close together side by side, one on either side of the median line. On the last 4–7 segments before the penultimate there is a single small median tubercle. In lateral view the cirri are practically of uniform width throughout. The dorsal processes are so low that at first sight the cirri appear smooth. The opposing spine is triangular, blunt, arising from the entire dorsal surface of the penultimate segment. It is small and inconspicuous, though larger than the processes on the preceding segments. The terminal claw is slightly longer than the penultimate segment, and is stout and moderately curved, usually rather more strongly proximally than distally.

The radials are visible as narrow curved bands beyond the rim of the centrodorsal. The IBr_1 are 5–6 times as broad as long in the median line, half again as long laterally as in the median line, with the distal border strongly concave and the lateral edges strongly convergent and slightly concave. The IBr_2 (axillaries) are broadly pentagonal, and are from half again to nearly twice as broad as long. Their lateral borders are about as long as those of the IBr_1, with which they make a very broadly obtuse angle. The lower ventrolateral angle is abruptly produced laterally in the form of a narrow high tubercle, over a similar abrupt lateral production of the anterior ventrolateral angle of the IBr_1. A small and abrupt synarthrial tubercle may be present on the articulation between the IBr_1 and IBr_2. Of the 10 IIBr series present 8 are 4(3+4) and 2 are 2. Of the 20 IIIBr series 18 are 2 and 2 are 4(3+4). The IVBr series are 4(3+4) except for a single one which is 2. Further division series, when present, are 4(3+4). The division series are narrow and very widely separated laterally. They are high and strongly convex dorsally, and small, abrupt, and rather high synarthrial tubercles are present at the synarthries. The ventrolateral borders of the ossicles bear rounded tubercular lateral processes at the ventrolateral angles that on the division series as a whole appear as a row of high rounded widely separated teeth. The outer division series and arms are unusually narrow.

The arms in the type specimen are 15+15+14+21+15=80 in number, 120 mm. long. The first brachials are trapezoidal, nearly twice as broad as the median length and nearly twice as long exteriorly as interiorly, inwardly united for the proximal half, the distal halves diverging at approximately a right angle. The second brachials are trapezoidal, and are somewhat larger than the first. The first syzygial pair (composed of brachials 3+4) is about half again as long as broad, and is somewhat constricted centrally. The next five brachials are approximately oblong, nearly as long as broad, after which the brachials become triangular, about as long as broad. The proximal oblong brachials are narrowly and faintly carinate.

Syzygies occur between brachials 3+4, 9+10, and 13+14, and distally at intervals of 3 or 4 muscular articulations. The second syzygy is sometimes between brachials 8+9 or 10+11, and is sometimes absent. The first syzygial pair is occasionally followed immediately by a second, consisting of brachials 5+6.

P_P is 13 mm. long and is composed of 18 segements (in three cases) of which the first is slightly broader than long, the second and third are slightly longer than broad (the third usually longer than the second), and the fifth and following are from two and one-half to three times as long as broad. The sixth and following segments have the distal end on the side toward the arm tip abruptly everted and finely spinous. The pinnule is rather stiff, though not rigid.

P_1 is 24 mm. long, very stiff and rigid, and much stouter than P_P, with 18 segments of which the first two are about one-third again as broad as long, the third is about one-third again as long as broad, and the remainder are between two and one-half and three times as long as broad. From the fifth onward the distal edges of the segments on the side toward the arm tips are abruptly and conspicuously everted and coarsely spinous, this character increasing in extent distally.

P_2 is 23 mm. long with 17 segments, similar to P_1 but more slender with the segments about three times as long as broad.

P_3 is 23 mm. long with 17–18 segments, and resembles P_2.

P_4 is 15 mm. long with 14 segments, shorter and more slender than P_3, though otherwise similar to it.

P_5 is 7–8 mm. long with 13–15 segments, very slender, delicate, and flexible. The first segment is about twice as broad as long, the second is trapezoidal and about as long as its proximal width, and the remainder are about three times as long as broad, becoming longer distally. The pinnules following are shorter and weaker.

The distal pinnules are 7 mm. long, very slender and delicate, with about 15 segments of which the first is about as long as broad, the second is about one-third again as long as broad, and the fourth and following are about four times as long as broad. From the third onward the segments have finely spinous distal ends.

P_a is always absent. On the inner arms on a IIBr series P_1, P_2, P_a, and P_b are usually absent; rarely P_1 is present and the others absent.

The color in alcohol is black tinged with purplish, the cirri somewhat lighter and more reddish.

Notes.—In the specimen from Cambodia as described by Gislén the centrodorsal is subconical, 6.5 mm. in diameter, with a small concave bare dorsal pole. The cirrus sockets are arranged in about four rows.

The cirri are XLIV, 41–51, from 28 to 40 mm. long. The longest earlier segments are from one-third again to twice as long as broad, and the distal segments are twice as broad as long. On about the twelfth segment a transverse ridge appears. Especially when observed from the distal end of the cirrus this ridge is seen to be crowned with small tubercles. At first the number of these tubercles is about 4, later rising to 7; on the distal segments there is a decrease to 5, 3, and finally to 2. There are 3 tubercles on the 3 to 6 segments before the antepenultimate, which last bears 2 spines only. The opposing spine is simple. The terminal claw is short and strongly curved.

The radials are visible as narrow bands. The IBr$_1$ are three times as broad as long, smooth, well rounded dorsally, and diverging from their neighbors. The IBr$_2$ (axillaries) are pentagonal, one-third again as broad as long. There is a well-circumscribed and prominent synarthrial tubercle on the articulation between the elements of the IBr series. Of the seven IIBr series present six are 4(3+4) and one is 2. The IIBr$_1$ is twice as broad as long. Of the thirteen IIIBr series present, twelve are 2, and one (abnormal) is 4(3+4). Of the eight IVBr series present, seven are 4(3+4) and one is 2. There is a synarthrial tubercle or the articulation between the two first elements of the IIBr series similar to that on the IBr series but smaller, and there are insignificant tubercles at the following synarthrial articulations.

P_{PP} seems always to be absent. On the inner arms (P_1), P_a, P_2, P_b, and even P_3 may be absent. P_D is short, smooth, and curved, with 15 segments.

P_1 is 23 mm. long with 20 segments of which the first is twice as broad as long, the second is half again as broad as long, the third is half again as long as broad, and those following are about twice as long as broad. This pinnule becomes flagellate distally. From the seventh onward the segments have everted and spinous distal ends.

P_2 is 19 mm. long with about 18 segments.

The pinnules following decrease in length. P_7, is 5 mm. long with 13 segments, and is smooth and slender.

The color is brownish violet, the smooth disk brown.

In the specimen from Pulo Condor the cirri are XXXVI, 49–51. There are not more than 5 eminences on the transverse ridge.

Of the ten IIBr series, eight are 4(3+4) and two are 2. Of the eleven IIIBr series, ten are 2 and one is 4(3+4). Of the eight IVBr series, five are 4(3+4) and three are 2. The remaining division series have been lost. There were probably about 50 arms.

The pinnulation is defective, as in the preceding specimen.

Localities.—Ternate; 2–4 meters; *Willebrord Snellius*, June 6, 1930 [A. H. Clark, 1936] (1, L. M.).

Pulo Condor, Cochin China; 15 meters; Dr. C. Dawydoff [Gislén, 1936].

Réam, Cambodia; littoral; Dr. C. Dawydoff [Gislén, 1936].

Geographical range.—From Ternate northward to Cochin China and Cambodia.

Bathymetrical range.—From the shore line down to 15 meters.

History.—This species was first described in February 1936, from a single specimen collected by Dr. H. Boschma, the biologist of the *Willebrord Snellius* expedition, at Ternate. On August 11, 1936, it was again described by Dr. Torsten Gislén under the name *Rhadinometra dawydovi*, new genus and species, from two specimens collected by Dr. C. Dawydoff in Cochin China and Cambodia.

Genus EPIMETRA A. H. Clark

Epimetra A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 542 (diagnosis; genotype *Epimetra nympha*); Crinoids of the Indian Ocean, 1912, p. 57 (in key), p. 138 (original reference; type); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 141 (referred to the Colobometridae); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 112 (in key).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 7, 123.—A. H. Clark, Temminckia, vol. 1, 1936, p. 305.

Diagnosis.—A genus of Colobometridae including small and very slender species in which the arms are about 40 in number and about 50 mm. long; all the division series are 2; the cirri are long and comparatively stout, 12 mm. long with about 40 segments of which the longest are slightly longer than broad; dorsally the cirrus segments bear a thin median keel, which may be paired; P_1, P_2, and P_3 are similar, rigid and much elongated with greatly elongated segments, 6–8.5 mm. long with 9–12 segments; P_2 is longer and somewhat stouter than P_1 and P_3; P_4 is similar, but shorter; P_a is always absent, and on the inner arms on each IIBr series P_1 is also absent.

The single species of *Epimetra* suggests a diminutive and very slender *Pontiometra* with the pinnulation of a *Colobometra*.

Geographical range.—Known only from between Palawan and Balabac Islands, Philippines.

Bathymetrical range.—Known only from 106 meters.

EPIMETRA NYMPHA A. H. Clark

PLATE 4, FIGURES 11, 12

Epimetra nympha A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 542 (description; *Albatross* station 5356); Crinoids of the Indian Ocean, 1912, p. 138 (synonymy; locality).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 1, 1934, p. 25.

Description.—The centrodorsal is small, hemispherical, with the dorsal pole convex, 1 mm. in diameter.

The cirri are XIII (deficient in 2 interradii), 37–39, 12 mm. in length. The first segment is short, and those following gradually increase in length, becoming about as long as broad on the fifth. The succeeding 4 to 6 segments are slightly longer than broad, and the following gradually decrease in length, those in the distal half of the cirri being nearly twice as broad as long. The eighth is a transition segment. The segments following have the distal dorsal edge slightly thickened and produced, and the dorsal surface developing a low narrow median keel which becomes more prominent in the outer part of the cirri so that the dorsal profile of the outer part of the cirri is scalloped. In dorsal view the opposing spine is a thick V-shaped or lobate production of the distal half of the penultimate segment; the 2 limbs of the V are thick proximally, tapering to a fine point at the apex. In end view this opposing spine is seen as a strong high crescent.

The radials are strongly produced in the interradial angles of the calyx where they separate the bases of the IBr_1 for a distance equal to about one-half of their dorsal width. The IBr, IIBr, and IIIBr series are all 2, and resemble the corresponding series in *Pontiometra andersoni*, but the component segments are somewhat longer and the synarthrial tubercles are more pronounced.

The 39 arms are about 50 mm. long and resemble those of *Pontiometra andersoni*, but the brachials are slightly constricted and have rather prominent ends.

On the outer arms borne by each postradial series P_a is absent; on the inner arms P_a and usually also P_1 are absent. P_1 on the outer arms is 6 mm. long, exceedingly slender, with 12 segments which are not quite so long as those of the following pinnule. P_2 is 8.5 mm. long, resembling P_1 but slightly larger and stouter and much stiffer, with 10 segments. P_3 is 6 mm. long, stiffer than P_1, with 9 segments which resemble those of P_2. P_4 is 4.3 mm. long, very slender, with 8 segments all but the first 2 of which are greatly elongated. The following pinnules gradually increase in length, the distal pinnules being 7 mm. long with 12 segments. P_b on the inner arms is 9 mm. long with 11 segments of which the first is not so long as broad, the second is half again as long as broad, the third is 3 times as long as broad, and the following are greatly elongated with swollen articulations, the last 2 or 3 having long and very slender spines upon their distal ends; the terminal segment, as usual, is short. The pinnule is exceedingly slender, but stiff and not flagellate.

Locality.—*Albatross* station 5356; North Balabac Strait, between Palawan and Balabac Island, Philippines; Balabac light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″ E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911, 1912, 1918] (1, U. S. N. M., 27492).

History.—As yet this species is known only from the single specimen dredged by the *Albatross* in 1908 and described by me in 1911.

Genus CENOMETRA A. H. Clark

Antedon (part) Hartlaub, Nachr. Ges. Göttingen, May 1890, p. 174, and following authors.

Himerometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 356.

Cenometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 8 (diagnosis; genotype *Himerometra unicornis* A. H. Clark, 1908); Vid. Medd. Naturh. Foren. København, 1909, p. 174 (included in the Colobometridae), p. 193 (probably occurs at Singapore, though not yet discovered there); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 4 (part of Bell's *Antedon emendatrix* is a species of this genus), p. 13 (common to southeast Africa and Ceylon, but not occurring in the Arabian Sea), p. 29 (arm division always external), p. 33 (character of P_2); Mem. Australian Mus., vol. 4, pt. 15, 1911, p. 730 (in key), p. 732 (in key), p. 735 (1 species in Australia), p. 772 (original reference; characters; range); Crinoids of the Indian Ocean, 1912, p. 10 (absent from Japan), p. 11 (represented in the Ceylon region, which is the western limit of the large and highly multibrachiate species), p. 12 (represented in the southeast African region), p. 22 (distribution in detail), p. 58 (in key), p. 153 (original reference; type); Unstalked crinoids of the *Siboga* Exped., 1918, p. 111 (in key).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 51 (obliquity of brachials), p. 84 (syzygies), p. 90 (articulation in the IBr series); Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5. No. 6, 1922, p. 76; Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, pp. 13, 14.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 48 (in key).

Diagnosis.—A genus of Colobometridae including large or medium-sized species with 12–39 arms 85–140 mm. long; the IIBr series are 2; P_2 is very stout, abruptly larger, stouter, and stiffer than P_1 or P_3, recurved and hornlike, the 11–23 (usually 15–20) segments with produced and spinous distal ends; the cirri are stout and strongly curved with 28–45 segments all of which are much broader than long and bear dorsally paired spines or tubercles; the elements of the division series and first two brachials bear flangelike ventrolateral extensions.

The stout curved cirri composed of very short segments bearing paired spines or tubercles dorsally, the much enlarged, stout, and stiff P_2, and the ventrolateral extensions of the elements of the division series and first two brachials make this genus easily recognizable.

Geographical range.—From Annam, the Bonin, Marshall, Fiji, and Philippine Islands to northwestern Australia, thence westward to Ceylon, the Seychelles, and Mauritius.

Bathymetrical range.—From the shore line down to 55 (66?) meters.

KEY TO THE SPECIES IN THE GENUS CENOMETRA

- a^1. No carination on the basal segments of the lower pinnules, except occasionally in very large individuals (from Annam, the Philippine, Bonin, Marshall, and Fiji Islands to Java and Sumatra, and northward to the Arrakan coast of Burma; 0–55 meters)---------**bella** (p. 27)
- a^2. Basal segments of the lower pinnules carinate.
  - b^1. No carination on the basal segments of P_2 though those of P_3 and the following pinnules are conspicuously carinate (Ceylon and the Gangam coast, Madras Presidency; 14–21 [?66] meters)---------**herdmani** (p. 43)
  - b^2. Basal segments of P_2 carinate.
    - c^1. Carination of the basal segments of P_2 slight, with the crest straight and parallel with the axis of the segments (northwestern Australia)---------**cornuta** (p. 44)
    - c^2. Carination of the basal segments of P_2 high and conspicuous, with the crest convex (Mauritius and the Seychelles)---------**emendatrix** (p. 46)

CENOMETRA BELLA (Hartlaub)

PLATE 3, FIGURES 9, 10; PLATE 5, FIGURES 20–24; PLATE 6, FIGURE 25; PLATE 7, FIGURES 28–30; PLATE 8, FIGURE 37

[See also vol. 1, pt. 1, fig. 16 (disk), p. 67; fig. 87 (lateral view), p. 143; fig. 345 (cirrus), p. 289; pt. 2, fig. 53 (radial pentagon), p. 33; fig. 122 (arm bases), p. 79; fig. 254 (arm), p. 205; fig. 274 (arm and pinnules), p. 213.]

Antedon bella HARTLAUB, Nachr. Ges. Göttingen, May 1890, p. 174 (description; Noordwachter Eiland, 15–20 fms.); Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 11 (collected by Brock), p. 37 (in key), p. 43 (detailed description and comparisons), p. 113 (in Göttingen Mus.), pl. 2, figs. 23, 26.—HAMANN, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 461 (listed); Crinoids of the Indian Ocean, 1912, p. 37 (of Hartlaub, 1891 = *Cenometra bella*), p. 40 (of Chadwick, 1904 = *C. herdmani*).—GISLÉN, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 4 (French Indo-China).

Antedon bella var. *brunnea* HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 44 (detailed description and comparisons; Noordwachter Eiland, 15–20 fms.).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 461 (listed); Crinoids of the Indian Ocean, 1912, p. 37 (identity).—GISLÉN, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 15 (relation to *C. unicornis*).

Antedon abbotti A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 148 (description; Pulo Taya, China Sea).

Himerometra abbotti A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 356 (listed); vol. 52, pt. 2, 1908, p. 217 (nearly related to *H. unicornis*).

Himerometra bella A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 356 (listed); vol. 52, pt. 2, 1908, p. 217 (nearly related to *H. unicornis*).

Himerometra unicornis A. H. CLARK, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 216 (description; *Albatross* station 5160; also stations 5141, 5147, 5163).

Cenometra abbotti A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 8 (listed); Crinoids of of the Indian Ocean, 1912, p. 153 (synonymy; locality); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in east Asia).

Cenometra bella A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 8 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 543 (*Albatross* station 5401); vol. 40, 1911, p. 4 (affinity with *Antedon emendatrix* not recognized by Bell); Crinoids of the Indian Ocean, 1912, p. 37 (identity of Hartlaub's record), p. 153 (synonymy; localities); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in east Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 4 (disk).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 4, 6, 76 (Bock's station 49; notes), p. 182; figs. 57–59, p. 70; fig. 74, p. 88; Zool. Bidrag Uppsala, vol. 9, 1924, p. 41 (details of arms), p. 51 (obliquity of brachials), p. 79 (syzygies), fig. 74, p. 81 (syzygial face), figs. 160, 161, p. 98 (pinnule articulations); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 25.—A. H. Clark, Temminckia, vol. 1, 1936, p. 307 (Ternate, 2–4 meters; notes).—Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 4 (French Indo-China), p. 6 (range), p. 15 (relation to *C. unicornis*); Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, pp. 13, 14.

Cenometra brunnea A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 8 (listed); Crinoids of the Indian Ocean, 1912, p. 37 (identity), p. 153 (synonymy; Amboina).—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, p. 14.

Cenometra unicornis A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 8 (listed), p. 145 (compared with *C. herdmani*), p. 146 (cirri compared with those of *C. insueta*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 399 (*Albatross* station 5108); Crinoids of the Indian Ocean, 1912, p. 153 (synonymy; locality).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25; Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 5 (French Indo-China), p. 6 (range), p. 14 (locality; notes), fig. 8, p. 18.

Cenometra delicata A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 398 (description; *Albatross* stations 5248, 5249); Crinoids of the Indian Ocean, 1912, p. 153 (synonymy; locality).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 33.

Cenometra insueta A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 146 (description; Arrakan coast); Crinoids of the Indian Ocean, 1912, p. 154 (synonymy; description; locality), fig. 21, *a*, *b*, p. 156 (labeled *C. herdmani*), but not fig. 19, a, b, p. 154 (labeled *C. insueta*).—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 85 (exchange of labels on the figures in A. H. Clark, 1912, noted).

Cenometra herdmani A. H. Clark, Crinoids of the Indian Ocean, 1912, fig. 21, *a*, *b*, p. 156 (dorsal and lateral views of a cirrus).

Cenometra abotti Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser. vol. 45, No. 11, 1934, p. 20.

Antedon (Cenometra) bella Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 2 (Bay of Tonkin).

Cenometra bella var. *brunnea* Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 15.

Cenometra bella var. *magnifica* Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, p. 3 (Fiji and Marshall Islands), p. 12 (localities; description; discussion), pl. 3, figs. 12, 13.

Cenometra abotti Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, p. 13.

Diagnostic features.—There is no carination on the basal segments of the lower pinnules. The arms are 19–39 (averaging about 25) in number, and are from 85 to 140 (averaging 112) mm. long. The cirri are XV–XXVI (usually about XX), 30–45 (usually about 35), and are from 16 to 30 (usually about 20) mm. long; the cirrus segments are usually nearly or quite twice as broad as long. P_2 is from 7 to 15 (usually about 11) mm. long, and is composed of 11–23 (usually about 19) segments; it is usually very stout and abruptly and conspicuously larger than the other pinnules, but in some cases it is only moderately stout.

Description.—The centrodorsal is thick discoidal, with the small polar area deeply concave. The cirrus sockets are arranged in 2 closely crowded more or less alternating rows.

The cirri are XX, 30–32, from 20 mm. to 25 mm. long, and stout. The cirrus segments are remarkably uniform, all about twice as broad as long, with very prominent distal dorsal ends which after the tenth become a pair of dorsal tubercles. The dorsal profile of the cirri is strongly serrate.

The radials are barely visible; their anterolateral angles are slightly separated. The IBr_1 are oblong, short, about 3 times as broad as long, rounded dorsally and widely separated laterally with a strong rounded triangular ventrolateral process on either side supporting the visceral mass. The IBr_2 (axillaries) are broadly pentagonal, rather over twice as broad as long, with a somewhat larger ventrolateral process on either side than the IBr_1. The IIBr and IIIBr series are 2, the latter developed only on the outer side of the postradial series. All of the elements of the division series and the first 2 brachials bear stout ventrolateral processes.

The 30 arms are 140 mm. in length. The first 8 brachials are oblong, about twice as broad as long, those following becoming slightly wedge-shaped, about twice as broad as long, then gradually less and less wedge-shaped and practically oblong again and about twice as broad as long in the distal half of the arms. Except for the proximal discoidal series the brachials have everted and finely spinous distal ends giving the arms a characteristic rough feeling, much as in *Catoptometra*.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 42+43 (usually in the vicinity of the thirtieth), and distally at intervals of from 6 to 12 (usually 7–9) muscular articulations.

P_1 is very slender, 12 mm. long with 28 segments of which the first 2 are about twice as broad as long, the following increasing in length to the fifth, which is about as long as broad, then slightly longer than broad, and about half again as long as broad distally. P_2 is 15 mm. long, very stout and stiff, with 20–23 segments the first 2 nearly twice as broad as long, the third about as long as broad, the remainder slightly longer than broad; the fourth or fifth and following have the distal ends dorsally and laterally everted and spinous, though ventrally they are unmodified. P_3 is smooth, 6 mm. long, or one-half the length of P_1, small but rather stiff, tapering evenly from the base to a slender tip, with 13 segments of which the distal are about half again as long as broad. P_4 is similar, but only 5 mm. long. The following pinnules are similar, but very gradually increase in length. The distal pinnules are 10 mm. long with 20 or 21 segments of which the first is nearly twice as broad as long, the second is trapezoidal and nearly as long as its greater (proximal) width, and the remainder are about half again as long as broad. All of the pinnules are somewhat stiffened.

The color in alcohol is reddish brown with the enlarged P_2 lighter, or yellow, the remaining pinnules nearly black in their proximal, white in their distal half; or light blue-gray with numerous small reddish-brown spots; the cirri are reddish brown.

Notes.—The preceding description is based upon the type specimen of *Himerometra unicornis* from *Albatross* station 5160.

As described by Dr. Gislén, the specimen from the Bonin Islands has the centrodorsal thick discoidal, 1.5 mm. in height, with raised margins about the bare dorsal pole, which is 2 mm. in diameter. The cirri are arranged in two marginal rows.

The cirri are XXVI, 34–38, from 16 to 18 mm. long. The first 12 segments are from one-third to one-half again as broad as long, and those following are similar or a little shorter. The segments in the distal half of the cirri have a low transverse ridge which is indistinctly, or not at all, divided into two tubercles, and which projects slightly in lateral view. The opposing spine reaches in height half the width of the penultimate segment. The terminal claw is stout and blunt and is about as long as the penultimate segment.

The radials are four times as broad as long, and are most evident in the interradial angles of the calyx; they are laterally united basally. The IBr_1 are three times as broad as long, and are free laterally. The IBr_2 (axillaries) are broadly pentagonal, half again as broad as long. There is a distinct synarthrial tubercle on the articulation between the elements of the IBr series. Each ossicle from the IBr_1 to the first brachial bears a ventrolateral extension which is largest on the $IIBr_1$ where it occupies the entire side of the ossicle and reaches one-fifth of its lateral height. The IIBr and IIIBr series are 2, the latter developed only externally. The ossicles immediately following each axillary are interiorly united.

The 26 arms are 90 mm. long. The brachials are rather smooth. There are 21 brachials to each 10 mm. of arm length, or 18 if the syzygial pairs are counted as units. The longer side of the distal brachials is two-thirds of their width, and the shorter side is half the width.

Syzygies occur between brachials 3+4 and 12+13, and distally at intervals of 7–10 (usually 7) umscular articulations.

P_1 is about 5 mm. long and consists of 18 segments. P_2 is 9 mm. long with 15 or 16 segments, and is very much stiffer and twice as stout as the other pinnules, or even stouter. The distal ends of the segments from the sixth onward are thickened and bear a row of spines. P_3 is 4 mm. long with 12 segments. P_4 is similar to P_3. P_a is always present, though often only from 2 to 3 mm. long. The distal pinnules are 7.5 mm. long with 17 or 18 segments of which the outer are from two to three times as long as broad.

The disk is incised, and is 8–11 mm. in diameter. The anal tube is short and pointed, 2.5 mm. high.

The color is white with small brown spots, the distal half of the pinnules quite violet-brown, the arms lighter with brown spots.

Gislén noted that this specimen only differed from the type specimen of *bella* in having somewhat more numerous cirri, which usually bear dorsally transverse ridges instead of a pair of tubercles, and in having the ossicles immediately following the axillaries only united basally.

In the type specimen of *Cenometra bella* var. *magnifica* from Jaluit, Marshall Islands, as described by Professor Gislén, the dorsal pole of the centrodorsal is flattened and pitted; the cirri are arranged in two closely crowded rows. The cirri are XXVIII, 42–45, from 22 to 28 mm. long. The longest proximal segments are half again as broad as long and the distal segments are twice as broad as long. A dorsal knob or indistinct transverse ridge occurs from the seventh segment onward, on about the fourteenth segment transforming into two very low knobs which fuse again into a low transverse ridge on about the thirty-eighth segment. In lateral view the knobs form a very low, blunt dorsal prominence. The opposing spine is broad and stout, its height equaling half the width of the penultimate segment. The terminal claw is thick and curved and is a little longer than the penultimate segment. The IBr_1 are four times as broad as long. The IBr_2 (axillaries) are pentagonal, twice as broad as long, and form a small but distinct synarthrial tubercle with the IBr_1. The $IIBr_1$ are interiorly united. The $IIBr_2$ (axillaries) are similar to the IBr_2. IIIBr series are present in at least five cases. The ossicles of the division series have ventrolateral processes. The 21+ arms are 110+ mm. long (detached arms are 140 mm. long) and are much broken. The distal ends of the brachials are a little thickened with a slightly spiny edge, these produced ends breaking the even profile of the arms. The second syzygy is at about the twentieth brachial, and the distal intersyzygial interval is about 10 muscular articulations. P_1 is 11 mm. long with about 30 segments; it is slender and smooth basally, the last 10 segments widened and spiny distally, thus forming spiny crowns wider than the base of the segment following. P_2 is 14.5 mm. long with 23 segments, very stout and hornlike; from the eighth segment onward there is a tuft of spines on the distal outer side of each segment, this tuft broadening to a semicircle on the outer segments. P_3 is 6.5 mm. long with 16 segments and, like the pinnules following, is almost smooth with traces of distal crowns on the proximal segments. The second-fourth segments of the proximal pinnules have a prominent crest on the outer side which is interrupted at the articulations. The distal pinnules are 11 mm. long with about 28 segments. The disk, which is detached, is very much incised; the smallest diameter is 5.5 mm., the largest 11.5 mm. The color is dark purplish, the distal portion of the arms brownish dorsally with large purple blotches.

Another specimen from Jaluit has the dorsal pole of the centrodorsal concave, and the cirri arranged in 2–3 closely crowded rows. The cirri are XLVII, 38–42, from 25 to 28 mm. long. IIIBr series are present in at least 10 cases. The ventrolateral processes on the arm bases are prominent. There are 29+ arms, all broken.

In a third specimen from Jaluit the cirri are XXII, 26–32, from 14 to 17 mm. long. The double tubercles on the middle segments are closer together and more distinct than in the two preceding specimens. The $IIBr_1$ are interiorly united basally. The ventrolateral processes on the arm bases have a small carination. The 27 arms are 80 mm. long, slender and smooth. P_1 is 5.5 mm. long with 18 segments. P_2 is 7 mm. long with 16 segments. P_3 is about 5 mm. long with 15 segments. There is no carination of the bases of the proximal pinnules.

In the specimen form Fiji, according to Gislén, the centrodorsal is 6 mm. in diameter with the excavated dorsal pole 2 mm. in diameter. The cirri are about XXX, 39–45, about 25 mm. long, with a transverse crest that develops into two very indistinct dorsal tubercles on about the thirtieth segment. The two tubercles are closely set and coalesce into a single small, well-circumscribed dorsal tubercle on the outer segments. The arms are very much broken, but were more than 20 in the complete specimen; detached arms are 100–120 mm. long. Ventrolateral carination is present on the proximal ossicles. P_1 is 7–8 mm. long with 15–18 segments. P_2 is 9–10.5 mm. long with 15–18 segments. P_3 is 4–5.5 mm. long with 14 segments. There is no carination of the basal portion of the proximal pinnules.

Professor Gislén said that the large specimens (that is, all but the third from the Marshall Islands) differ from all the other species of *Cenometra* except *C. abbotti* in having 40–45 cirrus segments. However, he said, in the species mentioned there are only XV cirri, the arms are 20 in number, and P_1 is very much shorter than P_2. Of the other species, he said, *C. bella*, *C. cornuta*, and *C. emendatrix* may have as many as 40 cirrus segments, or close to this figure. He noted that in *C. cornuta*, *C. emendatrix*, and *C. herdmani* the proximal pinnules have a more or less pronounced carination on the second and third segments just as in the two larger specimens from the Marshall Islands. On the other hand, the small specimen from the Marshall Islands has more slender and ventrolaterally smoother arms, a maximum of only 32 cirrus segments, and no carination of the bases of the proximal pinnules. He said that evidently it is a young individual, but if he had not had other specimens from the same locality he could easily have been tempted to consider it as another species. He remarked that so far as he could see all the "species" of the genus *Cenometra* are very little differentiated from each other. Characters such as 30 or 40 cirrus segments, the occurrence of ventrolateral processes on the arm bases, or carination of the bases of the proximal pinnules are, according to him, due to different degrees of development. He is not certain that the several species of *Cenometra* should not be included under one and the same species.

At present, he said, he prefers to consider the specimens from the Marshall Islands and Fiji as representing a variety of *C. bella*, the first species described in the genus *Cenometra*.

According to him the new variety (*magnifica*) differs from *bella* in having more cirri which in mature individuals have more segments, in having a proportionately longer P_1, and, in large specimens, in the presence of a carination on the bases of the proximal pinnules.

In the specimen from Annam the dorsal pole of the centrodorsal is bare, concave, 2.5 mm. in diameter. The cirri are XX, 35–36, about 25 mm. long. All the segments are short, the longest being from one-half to two-thirds as long as broad. From the third or fourth segment onward there is a transverse tubercle, which soon becomes transformed into a transverse ridge; this on about the tenth or twelfth develops into a 2-pointed or double dorsal spine, which becomes single on the antepenultimate segment. The opposing spine is large, its height being equal to about half the width of the penultimate segment.

There are small ventrolateral flanges from the IBr_2 to the $IIIBr_2$ or the first brachial. These flanges are interrupted at the articulations, this feature giving the basal portions of the arms a scalloped profile. Low synarthrial tubercles are present.

There are probably 31 arms, which are about 120 mm. long. The distal edges of the distal brachials are a little serrate; however, the profile of the arms is tolerably smooth.

The second syzygy is from between brachials 20+21 to between brachials 33+34. The distal intersyzygial interval is from 8 to 10 muscular articulations.

P_1 is about 10 mm. long, smooth, recurved, and slender, with 25 segments. P_2 is 12 mm. long with 19 segments, and very stiff; the segments are short, about as long as broad, and those from the seventh onward are distally edged with spines, especially on the outer side. P_3 is 7 mm. long with 15 segments and is smooth, like the pinnules following. The first-third segments of the distal pinnules are bluntly carinate.

The color is violet with large brown spots on the dorsal side of the brachials.

Gislén said that in regard to the proximal pinnules and the number of arms this specimen has the appearance of *C. unicornis,* but it approaches *C. bella* and its variety *brunnea* in having a tolerably high number of cirrus segments. It seemed to him doubtful whether *C. unicornis* could be kept separate from *C. bella.*

The specimen from Port Galera, Mindoro, has 30 arms about 100 mm. long. The cirri have 42–44 segments and are from 25 to 27 mm. long. P_2 is 14 mm. long, rather slender, with 19–21 segments of which the fourth and following are as long as broad or very slightly longer than broad.

The specimen from *Albatross* station 5401 has 23 arms 120 mm. long. The cirri have 36–39 segments.

The specimen from *Albatross* station 5248 was described as the type of a new species, *Cenometra delicata,* in the following terms: The centrodorsal is discoidal with the polar area slightly concave. The cirrus sockets are marginal, arranged in two closely crowded alternating rows.

The cirri are XIX, 31–33, 20 mm. long, and comparatively slender. The first segment is short, and the remainder are subequal and about twice as broad as long. The segments are somewhat flattened dorsally, after the tenth bearing very small blunt paired median dorsal tubercles. The opposing spine is triangular, arising from the entire dorsal surface of the penultimate segment, blunt, with the apex median in position. The terminal claw is about as long as the penultimate segment and is rather stout and strongly curved.

The ends of the basal rays are visible as flattened tubercles in the interradial angles of the calyx, but are difficult to differentiate from the centrodorsal.

The radials are visible, but short; their anterolateral angles are slightly divergent. The IBr_1 are trapezoidal, decreasing slightly in width distally, proximally about two and one-half times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, about twice as broad as long, with the lateral edges about as long as those of the IBr_1. The IIBr, IIIBr, and IVBr series are 2, the last only occurring on the outermost side of the postradial series. All the ossicles up to and including the second brachials have prominent ventrolateral processes the outer edges of which form a line parallel to the longitudinal axis of the ossicles that bear them.

The 35 arms are 85 mm. long, and are more slender than the arms of the other species in the genus. The brachials resemble those of *C. unicornis,* but are proportionately slightly longer.

The pinnules in general resemble those of *C. unicornis,* but P_2 is much more slender, 9 mm. long with 16–17 segments of which the first is nearly twice as broad as long, the third is about as long as broad, and those succeeding gradually become about one-third again as long as broad. The distal dorsal edge of the segments from the fourth onward is strongly produced, standing out in the form of a coarsely spinous crescentic ridge.

The color is deep violet, with the cirri, P_2, and the dorsal side of the other pinnules bright yellow.

The specimen from *Albatross* station 5249 is similar to the one just described. It has 34 arms. The color is entirely deep violet.

The specimen from Ternate is a fine example of the species with 29 arms 140 mm. long.

In the specimen from the Danish Expedition to the Kei Islands station 37 the centrodorsal is rather thin discoidal with sloping sides and a rather strongly concave dorsal pole. The cirrus sockets are arranged in a single marginal row, with a few additional sockets representing a partial second row alternating with the first.

The cirri are IX, 32–33, about 16 mm. long. The first segment is very short, between three and four times as abroad as long, and the fourth is about twice as broad as long. The sixth and following segments are about half again as broad as long. The first segment is slightly broader than the second, and the cirri taper almost imperceptibly distally. From the tenth or eleventh onward each cirrus segment bears dorsally a pair of small low blunt tubercles situated side by side. These occupy about the central half of the dorsal surface, the outer quarter on each side of them being free. On the last six or seven segments before the penultimate the tubercles become glassy, conical, and sharp. On the antepenultimate segment they are commonly absent; if present, they are usually fused into a low transverse ridge. The opposing spine is single, prominent, conical, glassy, median in position, and erect, arising from the entire dorsal surface of the penultimate segment and equal to about half the width of that segment in height. The terminal claw is scarcely so long as the penultimate segment, and is stout, rapidly tapering, and strongly curved.

The radials are approximately oblong with the distal border slightly and regularly concave, and are about six times as broad as the lateral length. They are in lateral contact. The IBr_1 are nearly or quite twice as long as the radials, and are about four times as broad as long. Their sides are parallel, but the ventrolateral border is produced in the distal two-thirds into a flangelike process which is highest at the distal end. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long, with the short lateral border produced ventrolaterally into a flangelike process somewhat broader than that on the IBr_1 and of uniform height. The proximal and distal sides are almost straight. The IIBr series resemble the IBr series, but the flange on the outer side of the $IIBr_1$ runs the entire length of the segment, and is as high as that on the axillary preceding. The division series are strongly convex dorsally, evenly rounded, and perfectly smooth, with no indication of synarthrial tubercles.

The 20 arms are 100 mm. long, all the ten IIBr series being developed. The first brachials are slightly wedge-shaped, the interior length being about two-thirds the exterior, and are about twice as broad as the median length. Their inner sides are completely in contact, or their inner distal angles may be separated by a slight notch. The outer sides are produced ventrolaterally into a broad flangelike process of which the crest is straight with broadly rounded angles, which is as broad as that on the segments preceding. The second brachials resemble the first, but exteriorly the flangelike process is displaced by the pinnule. The first syzygial pair (composed of brachials 3+4) is oblong, half again as broad as long. The next four brachials are approximately oblong, about three times as broad as long, that immediately succeeding is wedge-shaped, and those following are triangular, half again as broad as long. In the outer half of the arm the brachials become wedge-shaped again, then less obliquely wedge-shaped, and finally elongate.

P_1 is 7 mm. long with 17–20 segments, rather slender, and tapers gradually to a delicate tip. The segments become about as long as broad on the fourth, and terminally are about twice as long as broad.

P_2 is 7 mm. long with 11–14 segments, much stouter than P_1 and very stiff and rigid, tapering very slowly and recurved distally. The first segment is about three times as broad as long, and those following increase in length, becoming about as long as broad on the fourth and about one-third again as long as broad distally. The sixth or seventh and following segments have the outer portion of the distal border everted and very finely spinous, this feature being almost imperceptible at first and increasing in amount distally.

P_3 is 5 or 6 mm. long with 11 or 12 segments, small and weak, basally about as broad as, or narrower than, P_1, and distally tapering more rapidly. The first segment is short, the fourth is not quite so long as broad, the fifth is one-third again as long as broad, and the distal are twice as long as broad.

The color is light purplish gray with narrow deep purplish-brown lines along each articulation in the arms and pinnules. The division series have numerous rather large regular rounded spots of deep purplish brown. The cirri are light dull grayish.

In the specimen from Neira, Banda, the cirri are XXII, 35–43 (usually 35–36), 30 mm. long. The cirrus segments are subequal, about twice as broad as long. On the seventh or eighth segment the distal dorsal edge shows a noticeable thickening. This gradually becomes concave on its distal border, and at the same time the median portion of the dorsal surface becomes raised so that on about the fifteenth segment the dorsal surface bears a blunt median carination which, at about two-thirds of the distance from the proximal to the distal end of the segment, branches, the two branches running, at right angles to each other, to the distal edge. There is also a notch in the proximal end of the keel. The segments in the distal third of the cirri bear dorsally two elongated tubercles, one on either side of the middorsal line, which taper toward each end and in the middle are slightly concave exteriorly and more strongly convex interiorly so that they come into contact in the middorsal line, although their summits are always separated by a narrow groove. Toward the tip of the cirri they become progressively united, so that on the last six segments preceding the opposing spine there is simply a single elongated and rather narrow middorsal tubercle. The opposing spine is stout, conical, with the apex median, arising from the entire dorsal surface of the penultimate segment, its height being equal to about half the width of that segment. The terminal claw is about as long as the penultimate segment and is stout and rather abruptly bent at the end of the proximal third.

There are 39 arms 105 mm. long. The arms on the several postradial series are 4+4, 3+4, 4+5, 4+4, and 3+4. An additional division series on a postradial series is always external, or if a IIBr series bears three arms instead of the usual four the internal branch is undivided.

P_1 is 10 mm. long with 23 segments, moderately slender but not flagellate, tapering slowly and regularly from the base to the tip. The first segment is nearly twice as broad as long and those succeeding gradually increase in length so that the fifth is about as long as broad and the ninth or tenth and following are about twice as long as broad. The second-fifth segments have the outer side (toward the arm tip) moderately produced into a low carination with a straight crest and broadly rounded angles, the surface of which is roughened. The last five or six segments have the distal outer angle slightly overlapping the base of the segment succeeding, so that the outer profile of the pinnule tip is sharply and regularly serrate.

P_2 is 15 mm. long, stout and much stiffened, about twice as stout basally as

P_1 and tapering slowly and evenly to the tip. It is composed of 20 segments of which the first is twice as broad as long, the fourth is as long as broad, and the last four or five are about half again as long as broad. On the fifth a small portion of the distal edge on the outer side is somewhat produced and serrate, with a prominent ridge running downward from each tooth. This serrate portion of the distal edge rapidly increases in extent on succeeding segments so that on the seventh or eighth and following the whole outer half of the distal edge is moderately produced and everted, with conspicuous fine ridges running inward for a short distance from the teeth.

P_3 is 7.5 mm. long with 15 segments. It is not so broad basally as P_1, and tapers rather more rapidly in the first four segments. The first segment is about twice as broad as long, and the fifth and following are about twice as long as broad. The second, third, and fourth are rather strongly carinate, the carination being most prominent on the third because of the shortness of the outer border of that segment.

P_4 is 7 mm. long with 15 segments. It is not quite so broad basally as P_3 but tapers more evenly. The carination of the earlier segments is scarcely perceptible.

In the specimen from off Neira, Banda, the centrodorsal is discoidal, rather thin, with inwardly sloping sides and a small concave dorsal pole. The cirrus sockets are arranged in two closely crowded alternating rows.

The cirri are XXVI, 35–37, 30 mm. long, with the outer third, as preserved, strongly incurved. The cirri as a whole are rather slender. The first segment is about three times as broad as long, and the second and following are nearly or quite twice as broad as long, becoming half again as broad as long distally. The cirri taper very slightly in the distal third or fourth. The distal dorsal edge of the second and following segments projects slightly beyond the base of the segment succeeding. This projection very slowly increases, the produced edge becoming very finely serrate. On about the eighth to eleventh segment a depression appears in the midradial line, in end view forming a rounded notch in the projection, and after two or three segments the dorsal surface of the segments is seen to bear two prominent parallel longitudinal ridges that extend from the distal to the proximal border, each of which is situated midway between the middorsal line and the lateral border. One or two segments farther on the distal end of the ridges broadens so that they develop a T-shaped form, the cross bar of the T running slightly diagonally inward, and the inner end of the cross bars of adjacent T's almost meeting. On the succeeding segments the stem of the T becomes progressively shorter until the T is reduced to a caretlike angle with the apex inward, and on the seventh or eighth segment before the penultimate is reduced to a simple high and conspicuous, though blunt, tubercle. The two tubercles on the dorsal surface of each segment are quite separate from each other; their apices mark approximately the two ends of the middle third of the transverse width. On the antepenultimate segment the tubercles are fused basally. The opposing spine is much larger than the tubercles on the preceding segment, in lateral view broadly triangular and arising from the entire dorsal surface of the segment, in end view broadly triangular and arising from the entire width of the segment, and with the apex broadly rounded or truncated. The terminal claw is small, scarcely longer than the penultimate segment, stout basally but slender at the tip, rather abruptly curved in the proximal third.

The radials are almost entirely concealed by the centrodorsal. They are very short in the median line, but are somewhat longer laterally, the distal border being gently concave. The IBr_1 are short, about four times as broad as the median length, with the proximal and distal borders nearly straight and parallel and the sides converging slightly distally. They bear conspicuous ventrolateral processes which are broadest at the distal angle. The IBr_2 (axillaries) are broadly pentagonal, and are nearly twice as broad as long. Their sides are about as long as the sides of the IBr_1 and, as they converge slightly proximally, they make with these a very broadly obtuse angle. They bear on either side a conspicuous ventrolateral process which is as high as the maximum (distal) height of that on the IBr_1. The proximal and two distal sides are nearly straight. The IIBr series resemble the IBr series, but the ventrolateral processes on the outer sides of both elements extend for their entire length, and these processes are lacking on the inner sides. The IBr_1 are interiorly in contact for the proximal two-thirds, diverging distally at somewhat more than a right angle. The IIIBr series resemble the IIBr series, but the distal portion of the adjacent borders of the $IIIBr_1$ diverge at a right angle or less, and the ventrolateral processes are narrower and more ventral in position. The division series and first four brachials have an obscure broadly rounded median carination.

The 38 arms are 105 mm. long. The first brachials are slightly wedge-shaped, about two-thirds as long interiorly as exteriorly and about twice as broad as the median length. They are interiorly united for the proximal three-fourths beyond which point their interior borders diverge at a right angle. They bear exteriorly a ventrolateral process with a straight edge which is as broad as that on the preceding axillary. The second brachials are of about the same size as the first or slightly smaller, and are also slightly wedge-shaped. Owing to the presence of P_1 they lack the ventrolateral process. The first syzygial pair (composed of brachials 3+4) is oblong, and is nearly as long as broad. The next four brachials are oblong, about three times as broad as long. The brachials succeeding rapidly become triangular, twice as broad as long, after the proximal fourth of the arm obliquely wedge-shaped, twice as broad as long, and distally less obliquely wedge-shaped and longer. On the sixteenth or seventeenth brachial the median portion of the distal border is fringed with fine spines. On the brachials following this spinous fringe rapidly broadens and becomes more prominent, though the spines scarcely increase in length. Beyond the middle of the arm the dorsal surface of the brachials slowly becomes roughened, and finally more or less spinous. On the proximal oblong brachials the dorsal surface is more strongly curved centrally than laterally, so that the arms show a very obscure broadly rounded median ridge, but this gradually disappears as the brachials become wedge-shaped.

P_1 is 10–11 mm. long with 27–29 segments, tapering evenly and regularly and becoming slender, delicate, and flagellate in the distal half. The first two segments are about twice as broad as long, the fifth is about as long as broad, and the distal are from half again to twice as long as broad.

P_2 is 10–11 mm. long with 21 or 22 segments, basally not quite twice as broad as P_1, tapering very gradually, enlarged and stiffened, and moderately recurved toward the arm tip. The first segment is about twice as broad as long, the second is of about the same proportions or rather longer, the fourth is about as long as broad, and those following are slightly longer than broad, becoming nearly or quite half again as long as broad terminally. On the sixth segment a narrow but conspicuous abrupt fan of spines appears on the distal border in the sector toward the arm tip—that is, on the concave side of the pinnule as curved. This fan of spines rapidly broadens and increases in length, projecting diagonally over the bases of the segments succeeding and continues to the pinnule tip.

P_3 is 5–6.5 mm. in length with 15–17 segments. It is not so broad basally as P_1 and tapers gradually to the tip. The first segment is twice as broad as long, the fourth is about as long as broad, and the distal are twice as long as broad.

The pinnules following resemble P_3.

The color in alcohol is rather dark yellowish brown, with the pinnules and ventral surface purplish and the cirri deep purple.

The specimen from Pulo Taya was described as a representative of a new species under the name of *Antedon abbotti* as follows: The centrodorsal is saucer shaped, with the cirri marginal.

The cirri are XV, 40–45, 23 mm. long. They are long and stout, and the distal segments bear a small low tubercle (in reality two tubercles) dorsally.

The radials are just visible; their anterolateral angles are free. The IBr_1 are about twice as broad as long, and bear small tubercles distally on the lateral edges. The IBr_2 are pentagonal, rather long, also with lateral tubercles. The IIBr series are 2, and resemble the IBr series, but the $IIBr_1$ are in apposition for almost their entire length. The elements of the IIBr series and the first brachials have lateral tubercles. There is no further arm division.

The 20 arms are 100 mm. long. The first 8 or 9 brachials are oblong and those following are wedge-shaped, soon becoming triangular and about as broad as long.

The first syzygy is between brachials 3+4. In arms having an additional syzygy it is between brachials 42+43 (twice), 43+44, 45+46, 48+49, 55+56, and 91+92.

P_1 is 5 mm. long, tapering evenly from the base, and is composed of 20 squarish segments. P_2 is 12 mm. long, very stout, composed of 20 short segments. The following pinnules are rather smaller than P_1, becoming elongate distally.

The color in alcohol is dark purplish brown, with the cirri and the second pair of pinnules (P_2 and P_b) lighter and yellowish.

Hartlaub described *Antedon bella* from Noordwachter Eiland on the basis of four specimens as follows: The centrodorsal is of medium size with a small strongly concave dorsal pole.

The cirri are XV–XX, 35–40, reaching 20 mm. in length, moderately stout and only slightly tapering. All of the segments are broader than long. In the proximal half of the cirri the distal dorsal edges of the segments overlap the bases of the segments succeeding, and in the distal half the segments bear two small dorsal spines. The opposing spine is strong.

The radials are either visible, and then sometimes entirely free laterally, or are partially concealed. The IBr_1 are entirely free laterally. The IBr_2 (axillaries) are pentagonal, and are slightly, or not at all, longer than the IBr_1. The division series are widely separated. The IIBr and IIIBr series are 2. There are no IVBr series. The IIIBr series also may be absent, and if present occur only on the outer sides of the IIBr axillaries. There is a moderately strong thickening of the free outer borders of the elements of the division series, involving all the ossicles from the radials to the first brachials, which as a result have a very serrate appearance. The articulation between the axillaries and the preceding ossicles is sometimes somewhat tubercular.

There are not more than 20 arms, which are 115 mm. long. The arms are long and slender with a rather smooth dorsal surface and are composed of short brachials. Some arms may arise directly from a IBr axillary. The first brachials are approximately rhombic, and are almost entirely united interiorly. The second brachials are of the same size as the first, and are approximately rectangular. The first syzygial pair (composed of brachials 3+4) is squarish, or a little broader than long, and is succeeded by a few discoidal brachials, followed by a short series of triangular brachials, the brachials then becoming blunter and wedge-shaped, and finally more quadrate. The brachials have finely spinous distal ends that project somewhat, slightly overlapping the brachials succeeding.

The first syzygy is between brachials 3+4, the second is from between brachials 24+25 to between brachials 51+52, and those following occur at intervals of 10–15 (usually 10–11) muscular articulations. In arms arising from a IBr axillary the second syzygy may be between brachials 9+10, those succeeding occurring at intervals of at first 3–4 and later 6 muscular articulations.

P_1 is mostly only half as long as P_2, and has relatively smooth segments. P_2 is 8–10 mm. long, stouter and stiffer than P_1, and is composed of 12–22 segments of which some may be a little longer than broad. The segments have strongly produced dentate distal ends which on the outermost are beset with small spines. P_3 is markedly smaller, and even shorter, than P_1. It has smooth segments and agrees entirely with the following genital pinnules. These last increase slowly in length, reaching 9–10 mm. The two first pinnules on the inner side of the arms (P_a and P_b) are markedly smaller than the corresponding pinnules on the outer side of the arms (P_1 and P_2).

The disk is 11 mm. in diameter, and is deeply incised. Sacculi are closely crowded on the pinnules, but are more or less concealed by a thick gray-blue layer that covers the perisome and skeleton, and even extends over the small marginal ambulacral lappets of the pinnules, rendering these last unusually conspicuous.

The skeleton is light gray-blue with small reddish-brown dots. These on the division series and first 8 or 9 brachials are very numerous and without any definite arrangement, but on the outer portions of the arms thay have a regular distribution. Here each brachial has only one spot, which is on its shorter side, lying near the proximal border. The distal pinnules have in part the general gray-blue color, but in part are uniform red-brown, groups of pinnules of the two colors alternating. The cirri are uniform red or golden-brown.

Hartlaub considered as a variety of *Antedon bella*, which he called *brunnea*, a specimen that differed markedly from the typical form in color as well as in other ways.

The skeleton is dark brown, the cirri only being light brown. The pinnules have two or three narrow light gray bands. The disk is dark brown with very small white spots.

There are 19 arms; no postradial series has more than four. The arms are longer and thicker than in the typical form, the arm length reaching 135 mm. The first syzygial pair (composed of brachials 3+4) is quite square. The distal intersyzygial interval in arms arising from a IBr axiliary is 8–9 muscular articulations. The lower pinnules are markedly longer than in the typical form, and P_2 reaches 14 mm. in length, although the number of segments does not exceed 22. The ambulacral lappets of the pinnules, which in the typical form stand out so strongly because of their blue-gray color, are in the brown variety inconspicuous.

The specimen from the Arrakan coast was described as a new species under the name of *Cenometra insueta* as follows. With the arm and pinnule structure of *C. herdmani*, and the same slenderness of build, this species has the paired dorsal tubercles of the cirri situated with their apices much farther apart, about two-thirds of the transverse width of the dorsal surface of the segments instead of less than one-half. The specimen has 28 arms, and is badly broken.

Localities.—Dr. Sixten Bock's Expedition to Japan, 1914; station 49; Bonin Islands; the Channel; 64 meters; August 2, 1914 [Gislén, 1922, 1924].

Marshall Islands; Jaluit, reef west of the eastern entrance; Dr. Chr. Hessle, October 30 and November 1, 1917 [Gislén, 1940].

Fiji; Bau, Viti Levu, reef south-southeast of the islet; Dr. Sixten Bock, July 1917 [Gislén, 1940].

Nha'trang Bay, Annam; littoral; Dr. C. Dawydoff [Gislén, 1936].

Albatross station 5108; China Sea, off southern Luzon; Corregidor light bearing N. 39° E., 22.5 miles distant (lat. 14°05′05″ N., long. 120°19′45″ E.); 24 meters; coral; January 15, 1908 [A. H. Clark, 1909, 1912] (1, U. S. N. M., 36226).

Port Galera, Mindoro, Philippines; Dr. Lawrence E. Griffin (1, M. C. Z., 704).

Albatross station 5401; north of Cebu, Philippines; Tanguingui Island light bearing N. 79° W., 23 miles distant (lat. 11°24′45″ N., long. 124°06′00″ E.); 55 meters; fine sand; March 16, 1909 [A. H. Clark, 1911, 1912] (1, U. S. N. M., 35300).

Albatross station 5248; Gulf of Davao, southern Mindanao; Lanang Point bearing S. 33° W., 0.4 mile distant (lat. 7°07′25″ N., long. 125°40′24″ E.); 33 meters; coral; May 18, 1908 [A. H. Clark, 1909, 1912] (1, U. S. N. M., 25465).

Albatross station 5249; Gulf of Davao, southern Mindanao; Lanang Point bearing N., 1 mile distant (lat. 7°06′06″ N., long. 125°40′08″ E.); 42 meters; May 18, 1908 [A. H. Clark, 1909, 1912] (1, U. S. N. M., 35305).

Albatross station 5141; in the vicinity of Jolo (Sulu); Jolo light bearing S. 17° E., 5.5 miles distant (lat. 6°09′00″ N., long. 120°58′00″ E.); 53 meters; coral sand; February 15, 1908 [A. H. Clark, 1908, 1912] (2, U. S. N. M., 35267).

Albatross station 5147; Sulu (Jolo) Archipelago, in the vicinity of Siasi; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5°41′40″ N., long. 120°47′10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908, 1909, 1912] (1, U. S. N. M., 35297).

Albatross station 5160; Tawi Tawi group, Sulu (Jolo) Archipelago; Tinakta Island (N.) bearing S. 72° W., 2.75 miles distant (lat. 5°12′40″ N., long. 119°55′10″ E.); 22 meters; sand; February 22, 1908 [A. H. Clark, 1908, 1909, 1912] (2, U. S. N. M., 25441, 35301).

Albatross station 5163; Tawi Tawi group, Sulu Archipelago; Observation Island bearing N. 79° W., 6.7 miles distant (lat. 4°59′10″ N., long. 119°51′00″ E.); 51 meters; coral sand; February 24, 1908 [A. H. Clark, 1908, 1909, 1912] (2, U. S. N. M., 35269, 35306).

Ternate; 2–4 meters; *Willebrord Snellius*, June 6, 1930 [A. H. Clark, 1936] (1, L. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 37: about 40 meters; sand; April 23, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Neira, Banda; about 10 meters; sand; June 1, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; off Neira, Banda; 13 meters; sand; June 12, 1922 (1).

Pulo Taya, South China Sea, southeast of Linga Island, off the east coast of Sumatra (lat. 0°45′ N., long. 104°55′ E.); Dr. W. L. Abbott, July 1899 [A. H. Clark, 1907, 1909, 1912, 1913] (1, U. S. N. M., 22644).

Noordwachter Eiland, near Batavia, Java; 27–36 meters; Dr. J. Brock, 1884–'85 [Hartlaub, 1890, 1891; A. H. Clark, 1907, 1908 (erroneously given as Noordwachter Eiland, Gulf of Tonkin, and, under *Antedon bella* var. *brunnea*, as Amboina), 1909, 1912 (errors of 1908 repeated), 1913, 1915].

Investigator; Arrakan coast, Burma [A. H. Clark, 1909, 1912; H. L. Clark, 1915] (1, I. M.).

Erroneous localities.—Noordwachter Eiland (North Watcher Island), Gulf of Tonkin [A. H. Clark, 1908, 1912]. This refers to the small island of the same name off Batavia, Java.

Gulf of Tonkin [A. H. Clark, 1909]. This refers to the preceding locality.

Amboina [A. H. Clark, 1908, 1912]. This is an error for Noordwachter Eiland.

Geographical range.—From Annam, the Bonin, Marshall, Fiji, and Philippine Islands, to Java and Sumatra, and northward to the Arrakan coast of Burma.

Bathymetrical range.—From the shore line down to 55 meters. Dr. Bock's record of 64 meters represents the amount of line out, and not the actual depth at which the specimen was taken. The average of 13 records is 34 meters.

History.—This species was first described under the name of *Antedon bella* by Dr. Clemens Hartlaub in 1890 from four specimens which had been collected by Dr. J. Brock at Noordwachter Eiland, a small coral island near Batavia, Java. In 1891 Hartlaub redescribed in detail and figured *Antedon bella* and also described a well-marked variety under the name of *Antedon bella* var. *brunnea.*

Hartlaub said that *Antedon bella* is an undoubted new species, and may well be considered the most interesting of the new species collected by Professor Brock. It is distinguished especially by the unusual color, as well as by the fact that the lappets bordering the ambulacral grooves of the pinnules are overlaid with a layer of gray pigment. Dr. P. H. Carpenter, to whom Hartlaub sent a specimen of the new species, wrote him that the characteristic appearance of the lappets "seems to be due to a white filmy substance, which covers the whole perisome in parts, even the skeleton on the dorsal side and as it extends into the lappets of the ambulacral groove it produces the appearance of imperfect side plates."

Hartlaub said that in Carpenter's opinion *Antedon bella* stands nearest his *Antedon marginata* (=*Stephanometra spicata*) which, with *Antedon clemens* (=*Heterometra quinduplicava*), is distinguished by the absence of IIIBr series. Indeed, these may be entirely lacking in *Antedon bella* also, as is shown by one of the specimens with 20 arms and all the IIBr series present. But if we compare this with the others we see at once that the greatest irregularity and inconstancy in the division of the postradial series are characteristic of this species. For instance, one of the specimens has two postradial series that divide only once, one with two IIBr series, one with one IIBr and one IIIBr series, and lastly one with 6 arms, making in all 18 arms. But as a rule the postradial series have not more than four arms each. The division series are widely separated and bear on the central border of their outer branches, as in *Antedon marginata* (=*Stephanometra spicata*), irregular lateral processes. The cirri are noteworthy because of the large number of short segments, and the lower pinnules are remarkable in that those of the second pair are markedly longer than those of the first and third pairs, and the distal edges of their segments are produced and finely dentate.

In a paper on new unstalked crinoids from the coasts of northeastern Asia published on September 17, 1907, I described *Antedon abbotti* from a specimen collected by Dr. W. L. Abbott at Pulo Taya in the China Sea. In my first revision of the old genus *Antedon* published on October 29, 1907, I transferred Hartlaub's *Antedon bella* and my own *Antedon abbotti* to the new genus *Himerometra*.

In a list of the generic and specific names that have been applied to Recent crinoids, published on August 25, 1908, I gave as the locality for Hartlaub's *Antedon bella* Noordwachter Eiland (North Watcher Island), Gulf of Tonkin; but the Noorwachter Eiland from which the specimens came is a small coral island off Batavia, Java, as was stated by Hartlaub. This error arose through checking the locality with an Atlas in which the only Noordwachter Eiland given was the one in the Gulf of Tonkin, at the same time overlooking Hartlaub's allocation of the island. The fact that the specimens had been collected by Dr. J. Brock was also omitted. In the same paper the locality for *Antedon bella* var. *brunnea* was given as Amboina, whereas the specimen described under that name was from Noorwachter Eiland, and was taken with the typical specimens of *A. bella*.

In a paper on a collection of crinoids made by the *Albatross* in the Philippines published on December 23, 1908, I described *Himerometra unicornis* from station 5160, listing additional specimens from stations 5141, 5147, and 5163. I remarked that this new species is most nearly related to *H. bella* and *H. abbotti*. In a revision of the family Himerometridae published on January 9, 1909, I transferred *abbotti*, *bella*, *brunnea*, and *unicornis* to the new genus *Cenometra*. In the distribution of the genus *Cenometra* as given Ceylon refers to Chadwick's record of *Antedon bella*, which is in reality *C. herdmani*, and Gulf of Tonkin refers to Noordwachter Eiland. In a second paper on crinoids collected by the *Albatross* in the Philippines published on May 13, 1909, I described *Cenometra delicata* from station 5248, recording it also from station 5249, and listed *C. unicornis* from station 5108. In a paper on new Recent Indian crinoids published on June 25, 1909, I briefly diagnosed *Cenometra insueta*, which was based upon a single specimen that had been collected by the Royal Indian Marine Surveying steamer *Investigator* on the Arrakan coast of Burma. The diagnosis of this new species consisted solely of a comparison of its cirri with those of *C. herdmani* described on the previous page. In a third paper on crinoids from the Philippines collected by the *Albatross* published on February 15, 1911, I recorded *Cenometra bella* from station 5401. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Cenometra unicornis*, *C. delicata*, *C. abbotti*, *C. bella*, and *C. brunnea*, giving the synonymy and the habitat of each. The errors made in 1908 in regard to the habitats of the last two were repeated. The diagnosis of *Cenometra insueta* was repeated, and figures of a cirrus in lateral and dorsal view were given.

Dr. Hubert Lyman Clark in 1915 pointed out that the legends of the figures of the cirri of *Cenometra insueta* and of *C. herdmani* published by the author in 1912 had been interchanged and that the lateral and dorsal views of a cirrus labeled *Cenometra herdmani* in reality represented a cirrus of *C. insueta.*

Dr. Torsten Gislén in 1922 recorded and described in detail a specimen of *Cenometra bella* from Dr. Sixten Bock's Expedition to Japan, 1914, station 49, and in 1924 discussed various structural features of the species. In 1936 Dr. Gislén recorded and described a specimen from Annam and remarked that it was doubtful whether *unicornis* could be kept separate from *bella.* In 1940 he recorded and gave notes on one specimen from Fiji collected by Dr. Sixten Bock in 1917, and three from the Marshall Islands collected by Dr. Chr. Hessle in the same year. He considered these as representing a new form, which he called *Cenometra bella* var. *magnifica.*

CENOMETRA HERDMANI A. H. Clark

Plate 4, Figures 13–15; Plate 6, Figures 26, 27; Plate 7, Figures 31, 32; Plate 8, Figures 33, 35, 36

Antedon bella Chadwick, *in* Herdman, Report Ceylon Pearl Oyster Fisheries, pt. 2, suppl. rep. 11, 1904, p. 153 (occurs at Ceylon), p. 155 (stations LIII, LVII; characters).

Cenometra herdmani A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 145 (description; Ganjam coast; 12 fathoms); Crinoids of the Indian Ocean, 1912, p. 40 (=*Antedon bella* Chadwick, 1904), p. 154 (synonymy; description; localities), fig. 19, *a*, *b*, p. 154; fig. 20, p. 155; fig. 21, *a*, *b*, p. 156, p. 321 (off Gopalpore; notes).—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 85 (Ceylon; record of a fragmentary specimen; exchange of legends on the figures in A. H. Clark, 1912, noted).—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, pp. 12, 13.

Cenometra insueta A. H. Clark, Crinoids of the Indian Ocean, 1912, fig. 19, a, b, p. 154 (cirrus), but not description, p. 154, which is *C. bella.*

Cenometra herdmanni Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.

Diagnostic features.—The basal segments of the proximal pinnules, with the exception of P_2, are carinate. There are 20–30 arms. P_2 is more slender than it is in *C. bella.*

Description.—This species resembles *C. bella* in general appearance, but it is more slender, especially in regard to the cirri.

P_2 is comparatively slender and short, being only very slightly, when at all, longer than P_1; it is composed of relatively few segments, these numbering less than 20. There is no carination on the basal segments of P_2, though those of P_3 and the following pinnules are conspicuously carinate.

The paired dorsal tubercles on the cirrus segments, which are small, are very close together, their apices being separated by less than half the transverse width of the segments.

The arms are about 30 in number.

The color in alcohol is flesh color, the cirri and P_2 dull straw yellow, with a grayish wash on the disk which extends more or less over the division series; or, deep purple, evenly studded with small circular black spots, the cirri yellow-brown; or, flesh color with purple bands on the arms.

Notes.—The specimen recorded by Dr. H. L. Clark from Ceylon consisted of a calyx with the cirri and two arm bases attached.

Of the two specimens from the Ceylon Pearl Oyster Fisheries station LIII one, according to Chadwick, has 28 arms, and the other, now much mutilated, must have had the same number when living, IIIBr series being present on the outer side of both IIBr series on three of the postradial series.

The specimens from station LVII have 20 arms. A specimen apparently corresponding to Hartlaub's variety *brunnea* of *C. bella* was obtained at this station.

Localities.—Ganjam coast, Madras Presidency, India; 22 meters [A. H. Clark, 1909, 1912] (4, U.S.N.M., 35303; I. M.).

Bengal Fisheries steamer *Golden Crown;* Ganjam coast; 44–45 meters; March 8–16, 1909 [A. H. Clark, 1912] (1, U.S.N.M., 35302).

Bengal Fisheries steamer *Golden Crown;* off Gopalpore; 46–51 meters; September 23–27, 1909 [A. H. Clark, 1912] (2, U.S.N.M., 35304; I. M.).

Ceylon Pearl Oyster Fisheries station LVII; Gulf of Manaar; outside Dutch Moderagam Paar; 21–66 meters; bottom, orbitolites sand, nullipores, and dead corals [Chadwick, 1904; A. H. Clark, 1912].

Ceylon Pearl Oyster Fisheries station LIII; Gulf of Manaar; 10–12 miles north of Cheval Paar, and about 12 miles due west of Vankali (or Bangalli) Church; 14–16 meters; muddy sand, with some dead shells [Chadwick, 1904; A. H. Clark, 1912].

Ceylon [H. L. Clark, 1915] (1, Colombo, Ceylon, Mus.).

Geographical range.—From the Ganjam coast of India southward to Ceylon.

Bathymetrical range.—From 16 (?14) to 46 (?66) meters; the average of five records is 37 meters.

History.—The first mention of this species was by Herbert Clifton Chadwick, who recorded and gave notes upon specimens identified as *Antedon bella* from station LIII and LVII of the Pearl Oyster Fisheries investigations at Ceylon carried on in 1902 under the direction of Prof. (later Sir) William A. Herdman.

Under the name of *Cenometra herdmani* this species was briefly described by me in 1909, the description being based on specimens collected by the Bengal Fisheries steamer *Golden Crown* on the Ganjam coast of the Madras Presidency in 12 fathoms. In my memoir on the crinoids of the Indian Ocean published in 1912 I repeated the original description of the species, and recorded four specimens from the type locality and another from the Ganjam coast in 24–30 fathoms. I gave a somewhat schematic figure of the type specimen, in lateral view, and also figured a cirrus in lateral and dorsal view, for comparison with corresponding figures of a cirrus of *C. insueta* (=*bella*). Unfortunately the legends on the figures of the cirri were exchanged, undoubtedly through an oversight, so that the figures labeled *Cenometra insueta* in reality represent a cirrus of *C. herdmani* and *vice versa.* In 1915 Dr. H. L. Clark recorded a specimen from Ceylon and poited out the exchange of legends on my figures of cirri published in 1912.

CENOMETRA CORNUTA A. H. Clark

Antedon sp. (near *macronema*) Bell, Proc. Zool. Soc. London, 1894, p. 394 (northwest Australia.)—A. H. Clark, Mem. Australian Mus., vol. 4, pt. 15, 1911, pp. 719, 797 (identity); Crinoids of the Indian Ocean, 1912, p. 38 (identity).

Cenometra cornuta A. H. Clark, Mem. Australian Mus., vol. 4, pt. 15, 1911, p. 723 (Baudin Island), p. 772 (annotated synonymy; description; Adele Island; Baudin Island); Die Fauna Südwest-

Australiens, vol. 3, Lief. 13, 1911, p. 437 (northwest Australia; history), p. 441 (Australian tropical species occurring south to Adele Island), p. 444 (range on the west coast), p. 446 (summary of west Australian records); Crinoids of the Indian Ocean, 1912, p. 38 (identity of Bell's record), p. 156 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 33 (published reference to specimens in the B. M.; localities; characters of the specimens); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 224 and following (detailed account of the distribution in Australia).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25; Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, p. 13.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 48 (Australian records).

Diagnostic features.—The basal segments of all the proximal pinnules, including P_2, are carinate; the carination on the basal segments of P_2 is low, with the crest straight and parallel with the longitudinal axis of the segments. The arms are about 26 in number, about 110 mm. long. The cirri are XIV, 35–37, about 20 mm. long. P_2 is very stout, and is composed of 11–14 (usually 12) segments.

Description.—The cirri are XIV, 35–37, about 20 mm. long. They are rather slender and are composed of short segments none of which are less than twice as broad as long. The proximal segments are flattened dorsally. In the distal half of the cirri the segments bear dorsally a pair of tubercles with their apices well separated.

The ventrolateral processes on the elements of the division series are broad with truncated or roundedly incised outer margins.

There are in the type specimen 26 arms about 110 mm. long.

P_2 is very stout and very strongly curved, and is composed of 11–14 (usually 12) segments, most of which are about as long as broad. On the distal side the distal ends of the segments are strongly everted and serrate, this eversion being well marked even on the second segment. The first, second, and third segments of the earlier pinnules are slightly carinate, the carination being sharply truncated and straight edged so that the outer profile is straight and not convex as it is in *C. emendatrix.*

The color in alcohol is white and purple in bands about one-quarter of an inch in width. The cirri are brown.

Note.—The color of the specimen in the British Museum without locality is the same as that of the type specimen from Adele Island just described.

Localities.—Baudin Island, northwestern Australia [Bell, 1894; A. H. Clark, 1911] (1, B. M.).

Adele Island, northwest of Collier Bay and north of King Sound, northwestern Australia [Bell, 1894; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

No locality [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Geographical range.—Northwestern Australia from Baudin Island to Adele Island.

Bathymetrical range.—No depths have been recorded; but the dredgings that yielded all the known specimens were in shallow water.

History.—This species was first mentioned in a list of crinoids collected in northwestern Australia published by Prof. F. Jeffrey Bell in 1894 under the name of *Antedon* sp. (near *macronema*), the depth at which the specimens had been secured being represented by a "?". In 1910 I examined Professor Bell's specimens at the British Museum, and in my memoir on the recent crinoids of Australia published in 1911 I described them under the name of *Cenometra cornuta*, giving as the localities Adele Island (type locality) and Baudin Island. In my report upon the crinoids collected by the Hamburg Southwest Australian Expedition, 1905, published in 1911, I listed *Cenometra cornuta* from Adele Island and "northwestern Australia," and in my memoir on the crinoids of the Indian Ocean published in 1912 I listed it from the same localities. In my paper on the crinoids of the British Museum published in 1913 the specimen from Adele Island was redescribed, and a specimen without locality was recorded. This was the specimen from "northwestern Australia" mentioned in 1911 and 1912.

CENOMETRA EMENDATRIX (Bell)

Plate 8, Figure 34

[See also vol. 1, pt. 2, fig. 278 (arm and pinnules), p. 213.]

Antedon emendatrix Bell, Ann. Mag. Nat. Hist., ser. 6, vol. 9, 1892, p. 428 (description; Mauritius); pl. 18.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 4 (history; unsatisfactory character of the original description; referred to *Cenometra*).

Himerometra emendatrix A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 356 (listed).

Antedon spicata Bell, Trans. Linn. Soc. (Zool.), ser. 2, vol. 13, pt. 1, 1909, p. 20 (Seychelles).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (identity); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 87 (identity).

Cenometra emendatrix A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (= *Antedon spicata* Bell, 1909), p. 8 (occurs in southeast Africa), p. 28 (synonymy, detailed description of a specimen from Mauritius in the Berlin Mus.; localities; descriptions of additional specimens); vol. 43, 1912, p. 385 (identity), p. 399 (Mauritius); Crinoids of the Indian Ocean, 1912, p. 41 (= *Antedon spicata* Bell, 1909), p. 156 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 33 (published references to specimens in the B. M.; localities; characters of the specimens).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 235 (Mauritius, No. 6375).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 25.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (range), p. 104.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, p. 13.

Diagnostic features.—The basal segments of all the proximal pinnules, including P_2, are carinate; the carination of the basal segments of P_2 is high and conspicuous, with the crest strongly convex. There are 12–22 (averaging 16) arms which are from 90 to 100 mm. long. The cirri are XIV–XX, 28–41 (averaging 34), from 15 to 20 mm. long. P_2 is about 9 mm. long with 15–21 segments.

Description.—The centrodorsal is low hemispherical or thick discoidal with the sides strongly inclined, and is about 4 mm. in diameter. The dorsal pole is small and very slightly concave. The cirrus sockets are arranged in two crowded and irregular rows.

The cirri are XVIII, 28–33 (usually nearer the latter), from 15 to 20 mm. long, and comparatively slender. The first segment is short and those following gradually increase in length to the fourth which, with those following, is about half again as broad as long. The penultimate and antepenultimate segments are about as long as broad. After the eighth the distal dorsal edge of the segments begins to project slightly, this projection after the sixteenth becoming a pair of small, though prominent, dorsal spines situated close together, one on either side of the median line. On the antepenultimate segment only a single median small spine is found. In the terminal third of the cirri the paired dorsal spines, which at first were near the distal dorsal edge of the segments, have moved to a median position. The opposing spine is long and prominent, reaching somewhat over half the width of the penultimate segment in height;

it arises from nearly or quite the entire dorsal surface of the segment, and its apex is subterminal or median. The terminal claw is about as long as the penultimate segment, and is rather stout basally but is abruptly decurved and becomes comparatively slender in its distal half.

The radials are four or five times as broad as long, and their anterolateral angles are slightly separated. The IBr_1 are oblong, twice as broad as long. The IBr_2 (axillaries) are pentagonal, nearly or quite as long as broad, with a slight transverse median constriction. The IIBr series are 2, and resemble the IBr series. The elements of the division series and the first brachials bear comparatively short, though thick, ventrolateral processes. The division series are well separated.

There are 17 arms 90 mm. long. The arms are comparatively slender and delicate, increasing slightly in width to the twelfth or fourteenth brachials, thence gradually tapering distally. The first two brachials are subequal, wedge-shaped, about twice as broad as the exterior length. The first brachials are interiorly united for about the proximal two-thirds. The first syzygial pair (composed of brachials 3+4) varies from slightly longer than broad to slightly broader than long. The following three to five or six brachials are oblong, about twice as broad as long, those succeeding becoming very obliquely wedge-shaped, almost triangular, half again as broad as long, and in the distal part of the arm nearly or quite as long as broad. There is a slight development of small spines along the distal edges of the brachials.

Syzygies occur between brachials 3+4, again from between brachials 21+22 to between 30+31, and distally at intervals of from 9 to 25 (usually about 14) muscular articulations.

P_1 is small, slender, and weak, 5 or 6 mm. long, composed of 18–20 segments of which the second, third, and fourth bear broad carinate processes. The first four segments are broader than long, the fifth is about as long as broad, and those following are slightly longer than broad, becoming about half again as long as broad distally.

P_2 is stout and stiff, 9 mm. long, with 15–18 segments, and is much the largest pinnule on the arm, though it is not nearly so stout as in most of the allied species. The first two or three segments are broader than long and those following are about as long as broad, distally becoming slightly longer than broad. The distal ends of the segments are slightly produced and finely spinous, especially in the outer part of the pinnule.

The pinnules succeeding are small and weak, 4 mm. long with 11 segments of which the first two are broader than long, the third is about as long as broad, and those following slowly increase in length, becoming half again as long as broad distally.

The distal pinnules are very slender, 9 mm. long with 20 segments which distally become twice as long as broad or somewhat longer.

The color in alcohol is purple with the cirri and P_2 yellow and the other pinnules white.

Notes.—The preceding description was drawn up from the specimen from Mauritius in the Berlin Museum collected by Professor Möbius.

The four specimens from Mauritius in the British Museum upon which Professor Bell's original description was based have 21, 19, 14, and 12 arms. P_2 is comparatively slender. The proximal segments of the lower pinnules are strongly carinate.

One of the four specimens from the Seychelles in the British Museum has 22 arms

100 mm. long. There are two IIIBr series, both externally developed. P_2 has 19–21 segments, of which the basal are carinate. The cirri are XX, 32–35. Another has 14 arms 90 mm. long, and the cirri XIV, 34–41. A third has about 15 arms. The fourth, and smallest, specimen has 12 arms, one IBr axillary bearing a single IIBr series, which bears externally a IIIBr series.

Localities.—Mauritius [Bell, 1892; A. H. Clark, 1907, 1911, 1912, 1913] (4, B. M.).

Mauritius; Prof. K. Möbius [A. H. Clark, 1911, 1912; Hartmeyer, 1916] (1, Berl. M., 6375 [5349]).

Seychelles; 71 meters; J. Stanley Gardiner, *Sea Lark* Expedition [Bell, 1909; A. H. Clark, 1911, 1912, 1913] (4, B. M.).

Geographical range.—Mauritius and the Seychelles.

Bathymetrical range.—From shallow water down to 71 meters.

History.—This species was first described under the name of *Antedon emendatrix* by Prof. F. Jeffrey Bell in 1892, from specimens that had been sent to the British Museum from Mauritius.

In my first revision of the old genus *Antedon* published in 1907 *emendatrix* was referred to the new genus *Himerometra*.

In 1909 Professor Bell recorded, under the name of *Antedon spicata*, some additional specimens that had been collected by the *Sea Lark* under the direction of Prof. J. Stanley Gardiner at the Seychelles in 39 fathoms. He said in a footnote that he was in some doubt as to the correctness of this identification; P. H. Carpenter described the species (*Antedon spicata*) in 1881 from, it would appear, a single specimen, and no subsequent writer that he knew of had ever mentioned it.

In 1910 I examined at the British Museum the specimens recorded by Bell in 1892 from Mauritius and in 1909 from the Seychelles, and at the Berlin Museum studied an almost perfect specimen that had been collected by Prof. Karl Möbius at Mauritius. In 1911 I redescribed the species on the basis of the last mentioned specimen under the heading *Cenometra emendatrix*, giving under this heading the original reference, and also the reference to Bell's *Antedon spicata* recorded in 1909. I appended a summary of the characters of the eight specimens in the British Museum, the four original specimens and the four from the *Sea Lark* expedition. In a paper on the crinoids of the Berlin Museum published in 1912 I formally recorded Möbius's specimen from Mauritius, and in my memoir on the crinoids of the Indian Ocean published in the same year gave the synonymy and habitat of the species. In a paper on the crinoids of the British Museum published in 1913 I recorded and gave notes on the type specimens from Mauritius, and on the four collected by the *Sea Lark* in the Seychelles.

Dr. Robert Hartmeyer in 1916 corrected the catalog number of the specimen from Mauritius in the Berlin Museum recorded by me in 1912.

Genus COTYLOMETRA A. H. Clark

Oligometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 221.

Cotylometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 116 (diagnosis; genotype *Oligometra gracilicirra* A. H. Clark, 1908); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 111 (in key), p. 112 (in key), p. 128 (key to the included species).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnosis.—A genus of Colobometridae including small species with 10 arms 20–80 mm. long; the cirri have 24–39 smooth segments, the distal shorter than the proximal, those beyond the proximal fourth bearing long median dorsal spines; the proximal pinnules are rather short and somewhat stiffened, composed of rather short segments with spinous distal ends, and do not differ greatly in length; P_2 is the largest, with not more than 13 rather short segments; P_a may or may not be present; the segments of the genital pinnules are not broadened.

This genus is easily recognized by the rather long cirri of which the segments in the outer three-fourths bear long median dorsal spines, and the short and stiffened proximal pinnules composed of short segments with spinous distal ends.

Geographical range.—From the Philippine to the Kei and Andaman Islands.

Bathymetrical range.—From 80 to 113 meters.

History.—The single known species of this genus was described under the name of *Oligometra gracilicirra* in 1908, and a variety was described as *Oligometra gracilicirra* var. *ornata* in 1911. In 1916 it was made the type of the monotypic genus *Cotylometra.*

KEY TO THE FORMS IN THE GENUS COTYLOMETRA

a [1]. No keel on the IBr series and arms; edges of the elements of the IBr series and first two brachials unmodified (Philippine to the Kei and Andaman Islands; 85–113 meters).
gracilicirra gracilicirra (p. 49)

a [2]. The elements of the IBr series and the brachials in the proximal third of the arm each bear a narrow rounded median keel which on the first brachial may be reduced to a prominent tubercle; the outer edges of the ossicles of the IBr series and the first two brachials are bordered with a row of thickly set tubercles or small spines (between Borneo and Palawan; 80–106 meters) ---------- **gracilicirra ornata** (p. 5)

COTYLOMETRA GRACILICIRRA GRACILICIRRA (A. H. Clark)

Plate 8, Figures 38–40; Plate 9, Figures 41, 42

Oligometra gracilicirra A. H. Clark, Smithsonian Misc. Coll., vol. 52, part 2, 1908, p. 221 (description; *Albatross* station 5153); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O. studeri*); Vid. Medd. Nat. Foren. København, 1909, p. 179 (compared with *O. serripinna*); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544 (compared with *O. g.* var. *ornata*); Crinoids of the Indian Ocean, 1912, p. 168 (synonymy; Andaman Islands; notes; previous records), fig. 26, p. 169, p. 323 (2 specimens recorded lacking P_a on all the arms).

Cotylometra gracilicirra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 116 (range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 70 (compared with *Eudiocrinus indivisus*), p. 128 (in key; range; notes; stations 260, 305), pp. 275, 276 (listed), pl. 28, fig. 110.

Diagnostic features.—There are no keels on the IBr series and lower brachials, and the edges of the elements of the IBr series and the first two brachials are unmodified.

Description.—The centrodorsal is thick discoidal, with the rather large polar area thickly covered with small blunt spines. The cirrus sockets are arranged in a single marginal row.

The cirri are XV, 28–30, 12 mm. in length. The first segment is very short and those following gradually increase in length to the fourth, which is about as long as broad, and after the tenth become very slightly broader than long. The first and following segments have the distal dorsal edge everted, this eversion gradually becoming higher and narrower and transforming into a long sharp spine after the seventh. The opposing spine is as long as the width of the penultimate segment, and arises from the entire dorsal surface of that segment. The terminal claw is about as long as the penultimate segment, rather stout and moderately curved.

The radials are short, with a small median tubercle on the distal border. The IBr_1 are oblong, nearly 3 times as broad as long, with straight lateral borders which are just in apposition. The IBr_2 (axillaries) are broadly pentagonal, half again as broad as long.

The 10 arms are 55 mm. long. The first 2 brachials are wedge-shaped with the shorter side in, the first interiorly united for from one-half to two-thirds of their length, and both slightly flattened exteriorly. The first syzygial pair (composed of brachials 3+4) is nearly twice as broad as long, rather longer interiorly than exteriorly. The following brachials to the ninth are oblong, about twice as broad as long, after which they become obliquely wedge-shaped, about as long as broad, and gradually less and less obliquely wedge-shaped distally. After about the eleventh the brachials develop slightly overlapping and spinous distal ends. The division series and lower brachials bear a faintly indicated rounded median keel.

Syzygies occur ordinarily between brachials 3+4, 9+10, and 14+15, and distally at intervals of from 7 to 11 (usually 9) muscular articulations.

P_1 is about 2 mm. long, moderately stout, with 7 or 8 segments which are about as long as broad. P_2 is about 3 mm. long, considerably stouter than P_1, with 9–12 segments of which the first 2 are not quite so long as broad, the third is about as long as broad, and the remainder are slightly longer than broad. The third and following segments have strongly produced and spinous distal ends. P_3 is similar, but smaller. P_4, while similar to P_3, is about the size of P_1. After the twelfth or thirteenth the pinnules increase in length, reaching about 4.5 mm. distally.

The color in alcohol is white, with a broad median line of purple on the IBr series, the arms purple with a median line of white in their proximal third, the cirri white with a narrow band of purple about the middle of each segment; or white, the IBr series and arms with a lateral purple line which fades away distally on the arms, the cirri as before; or deep violet, the cirri yellow with the usual purple band on each segment.

Notes.—The preceding description is based upon the type specimen from *Albatross* station 5153.

The specimen from Amboina Bay has the cirri XI, 37–39, about 20 mm. long.

The specimens from *Siboga* station 260 are both small, with an arm length of 40 mm. In one the cirri have 31–36 segments, and P_2 has 12–13 (usually 13) segments. P_a is lacking on all the arms. In the other P_a is present.

In one of the specimens from the Danish Expedition to the Kei Islands station 54 the arms are 75 mm. long and the cirri have 30–32 segments. In another the arms are 75 mm. long and the cirri have 24 or 25 segments. In a third the arms are 70 mm. long and the cirri have 24–27 segments. In the fourth the cirri have 27 or 28 segments.

One of the specimens from *Siboga* station 305 has the arms 80 mm. long and the cirri IX (with a few undeveloped), 28–31, 15 mm. long. P_2 has 10 segments. The other has the arms 85 mm. long. P_a is absent. These specimens agree perfectly with the type, even in the details of their coloration; they are, however, slightly larger.

Of the five specimens from the Andaman Islands one, in a fairly good state of preservation, has the arms approximately 50 mm. long. The cirri are XV, 30–31, 12 mm. long. The segments of the proximal pinnules have exceedingly spiny distal ends, this character becoming gradually less marked and disappearing at about the tenth pair. The first and following cirrus segments have the distal dorsal edge everted, this eversion gradually becoming higher and narrower, and transforming into a long spine after the seventh. The color is white, the IBr series and arms with a lateral purple line which fades away distally on the arms; each cirrus segment has a narrow central purple band. When placed side by side with the type this specimen showed no differences. Three of the others resemble it. The remaining one is deep violet in color, the cirri yellow with the usual purple bands on each segment. The proximal pinnules are not so spiny as usual, and P_2 has about 12 segments instead of 9.

Localities.—*Albatross* station 5153; Tawi Tawi group, Sulu (Jolo) Archipelago, Philippine Islands; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5° 18′ 10″ N., long. 120° 02′55″ E.); 89 meters; coral, sand, and shells; February 19, 1908 [A. H. Clark, 1908, 1909, 1911, 1912, 1916, 1918] (1, U.S.N.M., 25444).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Amboina Bay, about 50 meters; stones and sand; March 2, 1922 (1).

Siboga station 260; 2.3 miles N. 63° W. from the north point of Nuhu Jaan, Kei Islands (lat. 5°36′30″ S., long. 132° 55′ 12″ E.); 90 meters; sand, coral, and shells; December 16 and 18, 1899 [A. H. Clark, 1918] (2, Amsterdam, Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 54; 85 meters; sand and coral; May 9, 1922 (4).

Siboga station 305; mid-channel in Solor Strait, off Kampong Menanga; 113 meters; stony bottom; February 8, 1900 [A. H. Clark, 1918] (2, U.S.N.M., E. 437; Amsterdam Mus.).

Investigator; Andaman Islands [A. H. Clark, 1912] (5, U.S.N.M., 35317 [original No. 36B], 35334 [original No. 20B], 35337 [original No. 22B]; I. M.).

Geographical range.—From the Philippines southward to the Kei Islands and westward to the Andamans.

Bathymetrical range.—From 85 to 113 meters. The average of 4 records is 94 meters.

History.—This species was described in 1908 as *Oligometra gracilicirra* from a specimen from *Albatross* station 5153. In 1912 five additional specimens were recorded from the Andaman Islands, where they had been dredged by the Royal Indian Marine Surveying steamer *Investigator*. Notes were given on these, and a more or less schematic figure of the species was published. In 1918 four specimens were recorded, with notes, from *Siboga* stations 260 and 305.

COTYLOMETRA GRACILICIRRA ORNATA (A. H. Clark)

[See vol. 1, pt. 2, fig. 199 (lateral view), p. 129; figs. 490, 491 (pinnule tip), p. 273.]

Oligometra gracilicirra var. *ornata* A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544 (description; *Albatross* stations 5355, 5356); Crinoids of the Indian Ocean, 1912, p. 168 (synonymy; localities).

Cotylometra gracilicirra ornata A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 70 (compared with *Eudiocrinus ornatus*).

Cotylometra ornata A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 128 (in key; range).

Diagnostic features.—The elements of the IBr series and the brachials in the proximal third of the arm each bear a narrow rounded median keel which on the first brachial may be reduced to a prominent tubercle, and the outer edges of the elements of the IBr series and the first two brachials are bordered with a row of thickly set tubercles or small spines.

Characters.—This form is in general similar to *C. gracilicirra gracilicirra*, but the broad IBr series and first two brachials, instead of just coming into apposition laterally and showing only a trace of lateral flattening, are sharply flattened against their neighbors, and their outer edges along the line of contact are strongly everted and strongly denticulate. The radials bear an abrupt rounded dorsoventrally elongate median tubercle. The IBr series have an abrupt more or less tuberculated median ridge which is continued on to the arm bases, becoming less noticeable as the brachials become triangular, but traceable to the distal portion of the arm. There is only a slight suggestion of this in *C. gracilicirra gracilicirra.*

The color pattern is the same as that in the specimens of *C. gracilicirra gracilicirra* at hand, but the color is much deeper.

Localities.—*Albatross* station 5355; North Balabac Strait, Philippine Islands; Balabac light bearing S. 61° W., 16.6 miles distant (lat. 8°08′10″ N., long. 117°19′15″E.); 80 meters; coral sand; January 5, 1909 [A. H. Clark, 1911, 1912, 1918] (3, U.S.N.M., 27493 [type], 35307, 35368).

Albatross station 5356; North Balabac Strait; Balabac light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911, 1912, 1918] (3, U.S.N.M., 35333, 35364).

Geographical range.—Only known from Balabac Strait, between Palawan and Borneo.

Bathymetrical range.—From 80 to 106 meters.

History.—This form was first described as *Oligometra gracilicirra* var. *ornata* in a paper published by me in 1911 on a third consignment of crinoids received from the *Albatross* during the course of her explorations in Philippine waters. In addition to the type specimen, two specimens were recorded from station 5355, and two similar specimens from station 5356. *Oligometra gracilicirra* var. *ornata* was listed with the synonymy and habitat and depth of the type locality in my memoir on the crinoids of the Indian Ocean published in 1912. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918, I included *ornata* in the key to the species of the genus *Cotylometra*, giving as the habitat Philippine Islands.

Genus AUSTROMETRA A. H. Clark

Oligometra (part) H. L. Clark, Mem. Australian Mus., vol. 4, pt. 11, 1909, p. 522.

Oligometrides (part) A. H. Clark, Die Crinoiden der Antarktis, 1915, p. 167.

Austrometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 115 (diagnosis; genotype *Oligometra thetidis* H. L. Clark, 1909; most closely related to *Analcidometra* and *Oligometrides*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 111 (in key; range).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 84, 90 (articulation in the IBr series), p. 94 (expansion of the pinnule segments), p. 100 (pinnule articulations); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.—H. L. Clark. Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 50.

Diagnosis.—A genus of Colobometridae including small species with 10 arms about 25 mm. long in which the third-fifth segments of the genital pinnules are broadened to protect the gonads; P_1 is the longest and stoutest pinnule, with 12 segments; the short and stout cirri have 14–17 (usually 15) segments, all of which except the penultimate bear a transverse ridge.

This genus is closely related to *Analcidometra* from which it is easily distinguished by the occurrence of a transverse ridge on all the cirrus segments preceding the penultimate.

Geographical range.—Coast of southeastern Australia from off Wollongong, New South Wales, southward to Bass Strait, between Australia and Tasmania.

Bathymetrical range.—From 102 (?100) to 128 meters.

History.—The single species of this genus was described under the name of *Oligometra thetidis* by Dr. Hubert Lyman Clark in 1909. In 1915 I transferred it to the genus *Oligometrides*. In 1916 I established the genus *Austrometra* with *Oligometra thetidis* as the genotype. This new genus was said to be most closely related to *Analcidometra*, with which it agrees in possessing expanded genital pinnules, a character not known to occur elsewhere in the family. Both *Austrometra* and *Analcidometra* were said to be related to *Oligometrides* more colsely than to any other type In 1918 I included *Austrometra* in the key to the genera of the family Colobometridae in my report on the unstalked crinoids of the *Siboga* expedition, and in 1934 Dr. Torsten Gislén discussed the articulations in the IBr series, the expansion of the genital pinnules, and the pinnule articulations in this genus.

AUSTROMETRA THETIDIS (H. L. Clark)

[See vol. 1, pt. 1, fig. 317 (cirrus tip), p. 273; fig. 354 (cirrus), p. 293; pt. 2, fig. 324 (proximal pinnules), p. 227; figs. 340, 341 (proximal pinnules), p. 229; figs. 498–501 (details of pinnules), p. 273.]

Oligometra thetidis H. L. Clark, Mem. Australian Mus., vol. 4, part 11, 1909, p. 522 (description; comparisons; off Wollongong, 55–56 fms.), pl. 47, figs. 1–3.—A. H. Clark, Die Fauna Südwest-Australiens. vol. 3, Lief 13, 1911, p. 441 (Australian tropical species occurring south to Wollongong); Mem. Australian Mus., vol. 4, 1911, p. 722 (confined to south Australia), p. 725 (related to *O. adeonae*), p. 735 (in key), p. 777 (original reference; detailed description; characters; locality; resemblance to *Analcidometra caribbea* [*armata*]); Records of the Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 267 (a species related to this and to *O. adeonae* discovered in the Andaman Islands); Crinoids of the Indian Ocean, 1912, p. 9 (confined to south Australia), p. 175 (synonymy; locality).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 22 (eastern slope, Bass Strait, 2 specimens).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 111, footnote 1 (type of *Austrometra*).—Pope, Australian Mus. Mag., vol. 8, No. 12, 1945, p. 407 (but not fig. on p. 406=*Metacrinus* sp.).

Oligometrides thetidis A. H. Clark, Die Crinoïden der Antarktis, 1915, p. 167 (range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, pp. 225 and following (detailed account of the distribution in Australia).

Austrometra thetidis A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 116 (range); Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41 (listed from Tasmania).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 79 (syzygies); fig. 165, p. 98 (pinnule articulation).—H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 40 (southwest of Gabo Island, New South Wales; 70 fathoms; notes).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 50 (localities).

Description.—The centrodorsal is low hemispherical with a rather large bare polar area. The cirrus sockets are arranged in 2 irregular closely crowded rows.

The cirri are XV–XX, 15 (rarely 14, 16, or 17), short and stout. The first segment is very short, the second is somewhat longer, the third is still longer, and the fourth and following are about as long as broad. The fourth and following segments bear a median transverse dorsal ridge which appears as a small spine in lateral view. At first the crest of this ridge as viewed from the end of the segments is practically a straight line, but it gradually becomes more and more convex and at the same time narrower so that on the terminal segments it resolves itself into a laterally elongated centrally arched tubercle. The opposing spine is short, but prominent, median, erect, equal in height to about one-fourth the width of the penultimate segment. The terminal claw is slightly shorter than the penultimate segment, stout and rather abruptly curved proximally, becoming slender and nearly straight distally.

The radials are between two and three times as broad as long. The IBr_1 are trapezoidal, about twice as broad as long, basally in lateral contact, gradually separating distally. The IBr_2 (axillaries) are broadly pentagonal, about half again as broad as long.

The 10 arms are about 25 mm. long. The first brachials are wedge-shaped, interiorly united for almost their entire length. The second brachials are similar, but proportionately longer. The first syzygial pair (composed of brachials 3+4) is oblong, about as long as broad. The following brachials to the eighth are oblong, about twice as broad as long, then becoming triangular and about as long as broad, and wedge-shaped and longer than broad distally. Synarthrial tubercles are more or less, but never strongly, developed.

Syzygies occur between brachials 3+4 and 7+8, and distally at intervals of 3–5 (usually 4) muscular articulations.

P_1 is comparatively long and stout, tapering uniformly from the base to the tip, with 12 segments of which the first is about as long as broad, the second is half again as long as broad, and the third and following are about twice as long as broad, slightly more proximally, slightly less distally. P_2 is similar, but considerably shorter, with 8 segments of which the first is somewhat broader than to as broad as long, the second is about half again as long as broad, and the remainder are about twice as long as broad. P_3 is shorter than P_2 with about 12 segments of which the first is not so long as broad, the second-fifth are about as long as broad and rather stout, and the remainder are longer than broad. P_4 is similar, but the third and fourth segments are slightly broader. The following pinnules have the third and fourth segments laterally expanded, forming a roof over the gonads; the fifth segment is expanded proximally but tapers distally, and the remaining segments are slender. This swollen and expanded condition of the pinnule segments persists practically unchanged to P_{15}, at which point the arms of the specimens examined are all broken off.

The color in alcohol is yellowish white, transversely banded on each segment with purple, rarely entirely yellowish white or entirely purple.

Notes.—The preceding description was drawn up by me from the original specimens which Dr. Hubert Lyman Clark was so very kind as to permit me to study at Cambridge, Mass.

Dr. Clark's original description is as follows:

> Centro-dorsal small, low hemispherical, nearly concealed by two marginal rows of cirri; these are about sixteen in number, 7–8 mm. long, with fifteen-eighteen joints besides the claw; basal joints wider than long, but distally they are squarish; each one, beginning with the fourth, has at middle of dorsal side, a transverse ridge, which in side view looks like a spine, that of the terminal joint being distinctly the largest, but even here not nearly equaling thickness of joint; on basal joints dorsal ridge somewhat serrulate, while distal margin of joint projects as a more or less evident second ridge;

in consequence of this arrangement, the dorsal side of some joints, notably fifth-eighth, appears as though provided with two low spines, one nearly at middle and one distal; terminal claw, usually sharp, curved and scarcely as long as penultimate joint. Radials plainly visible, but short; first costals [IBr_1] oblong, fully twice as wide as long, in opposition and slightly flattened on proximal half of lateral edges; costal axillaries (IBr_2] pentagonal, much wider than long. Ten arms, rather more than 25 mm. long; first brachials nearly oblong, much wider than long, more or less in contact proximally, outer side somewhat longer than inner; second brachial similar, but relatively longer; third and fourth brachials taken together [the first syzygial pair] as long as wide, squarish; fifth and sixth decidedly wider than long; the following nine or ten more or less wedge-shaped, but succeeding ones rather irregular; on distal part of arm the most distal portion of the distal edge of each brachial tends to project, though not sufficiently to be called a spine or even a tubercle. Syzygia occur between the third and fourth, and between the sixth and seventh, or rarely seventh and eighth brachials, and then at intervals of three oblique muscular articulations. First pinnule [P_1] nearly 6 mm. long, with ten-twelve joints, the first about as long as wide, second a little longer, third twice as long as wide, fourth and fifth about the same, the succeeding gradually decreasing in length, so that the minute terminal joint is scarcely longer than thick; all the joints are semi-cylindrical, smooth, furrowed on the inner face; second and third pinnules shorter, with only seven or eight joints, but otherwise similar; succeeding pinnules somewhat longer, those at middle of arm with as many as fifteen joints, of which the third, fourth and fifth are flattened and have conspicuously flaring margins; distal pinnules all somewhat broken. Sacculi more or less abundant, especially in distal pinnules. Colour, in alcohol, cream-colour, sometimes uniform, but usually with more or less distinct markings of purple; very rarely the entire animal is dull purplish, lightest towards the tips of the arms.

Dr. Clark said that three dry specimens from Gabo Island in the collection of the Australian Museum are somewhat smaller than the types, though otherwise similar. One is cream color, one is suffused with a reddish violet tint, and the third is distinctly light reddish violet with indistinct small areas of cream color.

Localities.—*Thetis* station 48; off Wollongong, 47 miles south-southwest of Sydney, New South Wales, Australia; 100–102 meters; sand and mud to rock [H. L. Clark, 1909, 1916; A. H. Clark, 1911, 1912, 1915, 1916, 1918; Gislén, 1924] (15, M. C. Z., 377; Australian Mus.).

West-southwest of Gabo Island, Victoria; 128 meters; Capt K. Moller, December 1929 [H. L. Clark, 1938].

Eastern slope, Bass Strait; *Endeavour* [H. L. Clark, 1916] (2, M. C. Z., 724; Australian Mus.).

Geographical range.—Coast of southeastern Australia from off Wollongong, New South Wales, to Bass Strait, between Australia and Tasmania.

Bathymetrical range.—From 102 (?100) to 128 meters.

History.—This species was first described under the name *Oligometra thetidis* by Dr. Hubert Lyman Clark from 15 specimens that had been dredged by H. M. C. S. *Thetis* at station 48. Dr. Clark said that it is closely allied to *adeonae* Lamarck and *bidens* Bell, but seems to be distinguished from both by the characteristic expansion of the genital pinnules. It differs from *adeonae* further in its smaller size, shorter first pinnules, and fewer cirri with fewer segments; the latter also appear to be rougher on the dorsal side. It differs from *bidens*, moreover, in the complete absence of the tubercles on the elements of the IBr series and lower brachials, in having a syzygy in the sixth or seventh brachial (though this is of little importance), and in somewhat different lower pinnules. Dr. Clark noted that there is some uncertainty about the pinnules of *bidens* as described by Bell; he says the first one has "some twelve joints" with "The most proximal joint the longest," while the figure given shows fourteen segments, the third and fourth decidedly the longest. In view of our imperfect view of *adeonae,* and the obvious resemblance between that species and both *bidens* and *thetidis,* it seemed to Dr. Clark quite possible that more abundant material will show that the three names belong to a single species.

In my report upon the crinoids of the Hamburg Southwest Australian Expedition published in 1911, *Oligometra thetidis* was given as a tropical species confined to Australia, but known only from Wollongong.

In my memoir on the crinoids of Australia published in 1911 I listed *Oligometra thetidis* as one of the seven species of crinoids confined to the southern part of Australia. Speaking of Australia, I said that here the genus *Oligometra* from the widely spread *serripinna* stock produces an entirely distinct species, *O. carpenteri,* which, as in the case of the Australian species of *Zygometra,* is the extreme form of the genus, and from a somewhat different branch (from which *O. thetidis* is also derived), *O. adeonae.* I remarked that I happened to be in Cambridge, Mass., when Dr. Hubert Lyman Clark received the collections of echinoderms brought together by H. M. C. S. *Thetis,* and that Dr. Clark had most courteously permitted me to examine the specimens of crinoids therein contained. I noted that this new *Oligometra* was a form of rather exceptional interest and that I had availed myself of the opportunity for drawing up a careful description of it, which I included. I had examined the type specimens of Lamarck's *adeonae* in Paris in the preceding year, and said that I could not see any grounds for believing that *thetidis* might eventually turn out to be *adeonae* as suggested by Dr. Clark. It is much smaller than that species, and the pinnules could not possibly be described as long, nor are the three or four first the longest. I remarked that in general appearance it is curiously similar to *Analcidometra caribbea* from the Caribbean Sea; it is of about the same size, the lower pinnules are more or less similar in shape and in proportions, and the genital pinnules are similarly expanded.

In a paper on a small collection of crinoids from the Indian Ocean published in July 1912, I mentioned *Oligometra thetidis* in connection with the supposedly related *O. marginata* (=*Iconometra marginata*) from Solor Strait. In my memoir on the crinoids of the Indian Ocean published on November 22, 1912, I listed *Oligometra thetidis* and gave its synonymy and habitat. In my memoir on the crinoids of the Antarctic published in 1915 I included in my list of the crinoids of southern Australia *Oligometrides thetidis* and gave the habitat.

In 1916 Dr. Hubert Lyman Clark recorded two specimens of *Oligometra thetidis* that had been dredged by the Australian Fisheries Investigation steamer *Endeavour* in Bass Strait. He said that these specimens are uniformly yellowish in alcohol and show no noteworthy peculiarities.

In 1916 I established the new genus *Austrometra* with *Oligometra thetidis* H. L. Clark, 1909, as the genotype, and in 1918 listed *Austrometra thetidis* as one of the crinoids known from Tasmania. In my report on the unstalked coinoids of the *Siboga* expedition published in 1918 I included *Austrometra* in the key to the genera of the family Colobometridae, in a footnote giving *Oligometra thetidis* H. L. Clark, 1909, as the genotype and saying that this genus is known only from southeastern Australia.

In 1924 Dr. Torsen Gislén described the syzygies and pinnule articulations of this species.

In 1938 Dr. H. L. Clark recorded and gave brief notes on three specimens that had been brought up from 70 fathoms off Gabo Island by Capt. K. Moller and presented to the Australian Museum.

GISLÉNOMETRA, new genus

Pachylometra (part) H. L. Clark, Ann. South African Mus., vol. 13, pt. 7, 1923, p. 234.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 18.

Diagnosis.—A genus of Colobometridae including small species with 10 arms about 25 mm. long in which the third and fourth segments of the genital pinnules are much broadened and the fifth less broadened to protect the gonads; P_1 is stout, stiff, and styliform with 6–9 segments, shorter than the less stiffened and curved P_2; and the cirri, which except for some of the peripheral are short and stout, have 15–21 segments which are without dorsal processes except for the opposing spine.

This genus is closely related to *Austrometra* from southeastern Australia from which it differs in the absence of dorsal processes on the cirri, and in having P_1, though straight, stout, and styliform, shorter than the recurved P_2.

Genotype.—*Gislénometra perplexa*, new species.

Geographical range.—Coast of southeastern Africa from East London, Cape Colony, to Durban, Natal.

Bathymetrical range.—From 238 (?146) to 567 meters.

History.—Specimens of the only species in this genus were recorded as the young of *Pachylometra sclateri* by Dr. Hubert Lyman Clark in 1923, and additional specimens were recorded under the same name by Prof. Torsten Gislén in 1938 who, however, doubted the correctness of the identification.

GISLÉNOMETRA PERPLEXA, new species

Pachylometra sclateri (part) H. L. Clark, Ann. South African Mus., vol. 13, pt. 7, 1923, p. 234 (*Pieter Faure* Nos. 12884, 13227), notes.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 18, text figs. 16, 17, p. 19, pl. 2, fig. 7.

Description.—The centrodorsal is high hemispherical with the dorsal pole broadly and evenly rounded. The cirrus sockets are arranged in a partially double irregular marginal row; where the row is double the lower socket is directly under the upper.

The cirri are XV, the longest with 17 segments and 5 mm. long. They are stout and strongly curved. The first segment is very short, the second is about twice as broad as long, the third is somewhat longer, and the fifth and following are slightly longer than broad, with the dorsal and ventral profiles nearly parallel. The distal segments, which in the stout cirri are about as long as broad, have the distal border finely serrate, though not everted or produced. The opposing spine, which arises from the entire dorsal surface of the penultimate segment, and not from the distal end as in the Charitometridae, is very broad, the two sides making nearly a right angle with each other. The terminal claw is about as long as the penultimate segment and is stout and evenly curved.

There are no basal rays.

The radials are about twice as broad as long, in close apposition laterally, with the distal border moderately concave. The dorsal profiles of the radials on opposite sides make an angle of about 90° with each other. The distal half of the radials is slightly turned outward. The IBr_1 are of about the same length as the radials or very slightly longer, somewhat over twice as broad as long, with the distal border a broadly obtuse angle and the anterolateral angles broadly rounded and slightly everted. The IBr_2 (axillaries) are half again as broad as long, pentagonal with the lateral borders about as long as those of the IBr_1, the proximal border a broadly obtuse angle fitting in to the corresponding angle on the distal border of the IBr_1, and the distal sides slightly concave. It is moderately convex and smooth dorsally. The proximal lateral angles are slightly everted.

The 10 arms are about 27 mm. long. The first two brachials are wedge-shaped with the outer border not quite twice as long as the inner. The first syzygial pair (composed of brachials 3+4) is oblong, about as long as broad. The next three brachials are oblong, about twice as broad as long, those following becoming wedge-shaped and after two or three more very obliquely wedge-shaped and longer than broad, in the distal part of the arm two or even three times as long as broad, and somewhat constricted centrally.

The proximal portion of the animal is much compressed, the profiles of the IBr series and arm bases diverging at an angle of about 45°. The IBr series are in close apposition and narrowly wall-sided. Beyond the first brachial the ossicles become much more deeply wall-sided, the flattened side of the seventh brachial extending inward to a depth greater than the length of the ossicle, reaching to about the end of the third segment of the pinnule on the preceding brachial. The wall-sidedness is continued as far as the ninth or tenth brachial. Up to this point the arm, as viewed dorsally, is stout, but from here on it tapers rather rapidly, soon becoming very slender.

Syzygies occur between brachials 3+4 and 9+10 and distally at intervals of 2 muscular articulations.

P_1 is 2 mm. long with 6 segments, stout at the base and tapering rather rapidly to the tip, stiff and styliform. The first segment is twice as broad as long, the second is somewhat broader than long, the third is somewhat longer than broad and tapers slightly distally, the fourth is about twice as long as the median width and tapers more rapidly, the fifth is about twice as long as broad with the sides almost parallel, and the last is much smaller, scarcely longer than broad. P_a is similar with the same number of segments, but only about two-thirds as large. P_2 is longer, about 2.2 mm. long, with 8 segments and is evenly curved distally; it is about as stout as P_1 basally but tapers more gradually. P_3 seems to resemble P_2 but is somewhat more curved. The genital pinnules, which are farther out on the arm than usual, have the third and fourth segments much broadened to protect the gonads, and the fifth wedge-shaped. The distal pinnules are exceedingly slender and hairlike with much elongated segments.

Conspicuous large dark sacculi are abundant on the pinnules.

The perisomic deposits in the pinnules consist of slender rods bent near the middle at an angle of about 120° and usually roughened at the larger end, together with short, straight, and apparently smooth rods. Broadly speaking, they are essentially similar to the deposits of *Oligometrides adeonae* (see Part 2, p. 246; fig. 793, p. 372), but the rods are more slender, smooth, the longer bent at an angle near the middle instead of being more or less regularly curved. It is difficult, however, to make out the details from dried material.

Notes.—The foregoing description was based upon a dry specimen from *Pieter Faure* No. 13227 very kindly lent me by Dr. H. L. Clark.

Dr. Clark regarded this species as the young of *Glyptometra sclateri.* In his account of that species he said that it was represented in the collection sent to him by an armless adult specimen and a number of quite young individuals. He said that the latter were rather puzzling owing to the small centrodorsal and the relatively long IBr series, and the presence in every case of just 10 arms. On the other hand, he said, the cirri are essentially like those of the adult (XV–XVI, 15–17) and the IBr series and lower brachials are distinctly wall-sided and in close apposition. He noted that in the young specimens the calyx is only 2 mm. in diameter and the cirri are 4–6 mm. long. P_1 is stiff and erect with 7 segments, and P_a is similar. P_2 is a little longer with 9 segments, and P_b is the same. P_3 and P_c are a little longer with 11 segments and are more flagellate at the tip. The following pinnules are shorter.

Prof. Torsten Gislén in 1938 recorded, like Dr. Clark under the name *Pachylometra sclateri* though with a question mark, three specimens from *Pieter Faure* No. 12884 (from which lot Dr. Clark had seen one specimen), and one from Dr. Th. Mortensen's station 25.

Of the three from *Pieter Faure* No. 12884 he said that the centrodorsal is flattened conical with the cirri in about 12 columns. The cirri are XVII, 15–19, 6–7 mm. long. The longest cirrus segments are one-third again as long as broad. There is an opposing spine, but the cirri are otherwise smooth. All are 10-armed young. The synarthrial articulations have a small, narrow, low, and indistinct tubercle. The first syzygy is between brachials 3+4 and the second usually between brachials 9+10. In one specimen the first four brachials are sometimes united in two synarthrial pairs. The distal intersyzygial interval is 2 muscular articulations.

In the specimen from Mortensen's station 25 the centrodorsal is subhemispherical, 1.7 mm. in diameter. The cirri are X, 21, 9 mm. long. The segments after the second or third are a little longer than broad, slightly broadened distally, the dorsal profile therefore serrate. The segments are provided with a distinct keel but there are no dorsal spines. An opposing spine is present. The terminal claw is shorter than the penultimate segment.

The radials are broad bands, a little everted and thickened distally and laterally. The IBr_1 are twice as broad as long, thickened and everted laterally and inconspicuously everted distally. There is a similar eversion also on the IBr axillary, which is pentagonal and half again as broad as long. On one abnormal postradial series there is an incomplete third element in the IBr series.

The 10 arms are all broken, but were 25+ mm. long. The brachials are smooth, without the eversion seen in the elements of the IBr series. The IBr series and the brachials as far as the fifth are wall-sided. After the tenth the brachials begin to be wedge-shaped, but they always remain smooth dorsally. There is a small but distinct synarthrial tubercle.

P_1 is about 2.5 mm. long with about 9 segments of which the longest are half again as long as broad. The following pinnules are mostly broken. The genital pinnules have about 12 segments of which the third and fourth are very much expanded.

The color in alcohol is white, the disk brown and studded with calcareous plates.

Professor Gislén said he was in much doubt whether the specimens he described were really referable to *sclateri.* He noted that the three smaller specimens were from one of the stations from which Dr. H. L. Clark got his young specimens. The specimen from Mortensen's station 25 is a little larger, the keel on the dorsal side of the cirrus segments is somewhat more distinct, and the lateral sculpture of the arm bases is a little more obvious, but the general appearance and the spacing of the syzygies is the same. However, he said, the specimen is still 10-armed and the ossicles of the division series are much longer (a feature which may of course be an indication of youth) than in the specimen figured by Bell. He remarked that, in fact, the genital pinnules are closely reminescent of *Charitometra.* Provided that it is not a young of *Pachylometra sclateri*, it is a new species which may probably be most correctly ranged within the 10-armed genus *Charitometra.*

In revising the family Charitometridae I noted Dr. Clark's remark that P_1 is stiff and erect with only 7 segments; Gislén's description of P_1 in which he said that the longest segments are half again as long as broad; and the fact that neither mentioned side or covering plates, which are highly developed and conspicuous in the young of all the species of Charitometridae. Gislén figured the genital pinnules, showing the greatly broadened third and fourth segments, but no plating of the brachial ambulacra or perisome. The stiff pinnules at the base of the arm composed of few long segments combined with the expanded third and fourth segments of the genital pinnules and the absence of side and covering plates made it evident that these specimens could not belong to any of the species of Charitometridae, but strongly suggested the genera *Austrometra* and *Analcidometra* of the Colobometridae. Dr. H. L. Clark was so very good as to send me a specimen for examination, and I found my supposition confirmed.

On referring to my personal notes I find that I was in Cambridge when Dr. Clark was working on the South African collection, and furthermore that I had acquiesced in the identification of these little specimens as the young of *Pachylometra sclateri.* I am therefore quite as much to blame as they for the confusion that has resulted.

Localities.—*Pieter Faure* No. 12884; East London, Cape Colony, bearing N. 15 miles distant; 567 meters; mud [H. L. Clark, 1923; Gislén, 1938].

Pieter Faure No. 13227; Cove Rock, near East London, bearing N. W. 3/4 W., 13 miles distant; 146–238 meters; coral rock [H. L. Clark, 1923; Gislén, 1938] (4, M. C. Z., 737 [type], 752).

Dr. Th. Mortensen's station 25; off Durban, Natal; 411 meters; sandy mud; August 26, 1929 [Gislén, 1938].

Geographical range.—Coast of southeastern Africa from East London, Cape Colony, northward to Durban, Natal.

Bathymetrical range.—From 238 (?146) to 567 meters.

History.—The first known specimens of this species, one from *Pieter Faure* No. 12884 and thirteen from *Pieter Faure* No. 13227, were recorded by Dr. Hubert Lyman Clark in 1923 as young individuals of *Pachylometra sclateri*, and a few notes on them were given.

Prof. Torsten Gislén in 1938 gave brief notes on three dried specimens from *Pieter Faure* No. 12884 and more detailed notes on a large specimen from Dr. Th. Mortensen's station 25. Noting that the expanded genital pinnules in Mortensen's specimen are closely reminiscent of *Charitometra*, he said that provided it is not a young individual of *Pachylometra sclateri*, to which he referred his specimens though with considerable doubt, it is a new species which may probably be most correctly ranged within the 10-armed genus *Charitometra*.

Genus OLIGOMETRIDES A. H. Clark

Comatula (part) Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 2, 1816, p. 535.

Alecto (part) J. Müller, Arch. Naturg., 1841, vol. 1, p. 142.

Antedon (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29, and following authors.

Milberti group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 376.

Himerometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 356.

Oligometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126.

Oligometrides A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 37 (no diagnosis and no genotype mentioned; name used in combination with [*Comatula*] *adeonae* Lamarck); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, p. 4 and following (represents *Analcidometra;* range and its significance); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (corresponds to *Analcidometra*); Journ. Washington Acad. Sci., vol. 5, No. 1, 1915, p. 9 (confined to Australia; most closely related to *Analcidometra*); Die Crinoiden der Antarktis, 1915, p. 167 (range), p. 181 (range; represented in the Atlantic by *Analcidometra*); A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 116 (closely related to *Analcidometra* and *Austrometra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 111 (in key), p. 126.—Gislén, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 33 (discussion); Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 90; Zool. Bidrag Uppsala, vol. 9, 1924, p. 51 (obliquity of the brachials), p. 84 (syzygies), p. 89 (articulations).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 643.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 50.

Oligemetrides Gislén, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 28.

Diagnosis.—A genus of Colobometridae in which the 10 arms are 35–70 (usually about 50) mm. long; the cirri are short and stout with 17–32 (usually about 20) segments, each bearing dorsally two transverse ridges, a proximal and a distal; P_1, P_2, and P_3 are smooth, enlarged, and stiffened, decreasing in length from P_1, with 9–20 (usually 10–13) segments; all the pinnules are present, and the genital pinnules are not broadened.

This genus is closely allied to *Iconometra* from which it differs in having two transverse ridges on the cirrus segments, and in having P_1 the longest pinnule.

Geographical range.—Aru Islands and northern Australia south to Port Curtis, Queensland, and Cape Jaubert, Western Australia.

Bathymetrical range.—From the shore line down to 22 (?37) meters.

History.—The only known species of this genus was described by Lamarck as a species of *Comatula* in 1816. It was transferred to the genus *Alecto* by Johannes Müller in 1841. In 1879 it was placed by Dr. P. H. Carpenter in the genus *Antedon.* In 1888 Carpenter placed Lamarck's *Comatula adeonae* and Bell's *Antedon bidens* described in 1884—a synonym of *adeonae*—in a list of 10-armed species that did not seem to fit into any of the specific groups established by him within the genus *Antedon;*

but *pinniformis*, to which he referred a specimen of *adeonae* in addition to the type specimen, he placed in the *Milberti* group.

In my first revision of the genus *Antedon* published in 1907 Lamarck's *adeonae* was retained in the genus *Antedon*, but Bell's *bidens* was placed in the new genus *Himerometra*. On the establishment of the genus *Oligometra* in 1908, however, both *adeonae* and *bidens* were referred to it. In recording the specimens of *adeonae* in the British Museum in 1913 I used the new generic name *Oligometrides* with no explanation, and the combination *Oligometrides adeonae* was used twice in 1914, twice in 1915, and once in 1916, similarly without explanation. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *Oligometrides* in the key to the genera of the Colobometridae, thereby defining it for the first time.

OLIGOMETRIDES ADEONAE (Lamarck)

Plate 9, Figures 43, 44

[See also vol. 1, pt. 1, fig. 353 (cirrus), p. 293; pt. 2, figs. 793, 794 (ambulacral deposits), p. 372.]

Comatula adeonae Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 2, 1816, p. 535 (description; Australia).—de Blainville, Dict. Sci. Nat., vol. 10, 1818, p. 108 (from Lamarck).—Lamouroux, Encyclopédie méthodique, vol. 2, 1824, p. 206 (same).—de Blainville, Dict. Sci. Nat., vol. 60, 1830, p. 229 (same); Manuel d'actinologie, 1834, 1836, p. 249 (from Lamarck) but not pl. 26 [=*Heterometra savignyi*, from Savigny, 1817, as *Comatula multiradiata*].—Lamarck, Histoire naturelle des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 471.—[Anonymous], Penny Encyclopedia, vol. 7, 1837, p. 361 (from de Blainville) [figure is from Savigny, 1817, *Comatula multiradiata*=*Heterometra savignii*].—Deshayes and Milne-Edwards, Histoire naturelle des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 211.—J. Müller, Arch. Naturg., 1841, vol. 1, p. 142; Abh. Preuss. Akad. Wiss., 1847, 1849, p. 251 (redescribed).—Dujardin and Hupé, Histoire naturelle des zoophytes, Échinodèrmes, 1862, p. 200 (synonymy; description; seas of Australia), p. 203 (under *Comatula savignyi;* identification of de Blainville's figure).—W. B. Carpenter, Phil. Trans. Roy. Soc., vol. 156, 1866, p. 697 (distinct from *Comatula adeonae* Delle Chiaje, which is *Antedon rosaceus* [*mediterranea*]).—[Knight], Natural History, or second division of the English Encyclop., vol. 2, 1867, p. 99 (text; figure is *Heterometra savignii* from Savigny, 1817).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 507 (status of the species); Amer. Nat., vol. 43, 1909, p. 254 (explanation of de Blainville's figure); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 1 (same); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 244 (identity); Mem. Australian Mus., vol. 4, 1911, p. 710 (history); Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Alecto adeonae J. Müller, Arch. Naturg., 1841, vol. 1, p. 142 (from Lamarck); 1843, vol. 1, p. 135 (redescribed).

Antedon adeonae P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (listed as an *Antedon*).—Bell, Proc. Zool. Soc. London, 1882, p. 532 (listed), p. 534 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 746 (specific formula).—Bell, Rep. Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula), p. 156 (Port Curtis and Port Denison).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 55, 206, 366, 378 (discussion; Queensland).—A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 353 (listed).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, p. 714 (of *Alert* report=*adeonae* + *Tropiometra*, sp.), p. 716 (credited to Australia by P. H. Carpenter), p. 797 (part of Bell's record based upon *Tropiometra* sp.); Crinoids of the Indian Ocean, 1912, p. 31 (of Bell, 1884=*Tropiometra* sp.+*Oligometra adeonae*), p. 34 (of P. H. Carpenter, 1888=*adeonae*), p. 175 (synonymy; localities; notes); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 80 (of Bell, 1884=*Oligometrides adeonae*+*Tropiometra* sp.).

Antedon pinniformis Bell, Rep. Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula), p. 156 (Dundas Strait).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 378 (North-West Australia [but not New Guinea]).

Antedon bidens Bell, Rep. Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula), p. 158 (description; Torres Straits), pl. 11, figs. A, *a–c;* Ann. Mag. Nat. Hist., ser. 6, vol. 2, 1888, p. 404 (comparison with *A.* [*Compsometra*] *incommoda*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 54, 206, 366, 378 (discussion; Torres Straits).—Döderlein, Denkschr. med.-nat. Ges. Jena, vol. 8, vol. 5, 1898, p. 476 (Thursday Island; notes), pl. 36, figs. 3–3*d*.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).—A. H. Clark, Bull. Mus. Hist., Paris, 1911, No. 4, p. 255 (synonym of *adeonae*); Mem. Australian Mus., vol. 4, 1911, pp. 714, 716, 720 (synonym of *adeonae*); Crinoids of the Indian Ocean, 1912, pp. 31, 34, 39 (same); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 80 (same).—H. L. Clark, The echinoderm fauna of Torres Strait, 1921, pp. 6, 7 (identity).

Himerometra bidens A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 356 (listed).

Oligometra adeonae A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (listed); vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*).—H. L. Clark, Mem. Australian Mus., vol. 4, part 11, 1909, p. 523 (compared with *O.* [*Austrometra*] *thetidis*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 172 (cirri compared with those of *Comaster taviana*); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 244 (=*Comatula adeonae* Lamarck), p. 255 (Australia; description of type; includes *Antedon bidens* Bell); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (collected at Dundas Strait by the *Alert*), p. 441 (Australian tropical species occurring to Baudin Island and Port Curtis), p. 443 (range on east coast), p. 444 (range on west coast), p. 446 (summary of west Australian records); Mem. Australian Mus., vol. 4, 1911, p. 717 (known to P. H. Carpenter from Australia), p. 722 (occurs south to Port Curtis), p. 723 (northwest Australia; Dundas Strait; Baudin Island), p. 725 (related to *O.* [*Austrometra*] *thetidis*), p. 734 (in key), p. 776 (synonymy; characters; Australian records; description of types, and of types of *bidens*); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 23 (cirrals compared with those of *Comantheria weberi*); Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 267 (a species related to this and to *O.* [*Austrometra*] *thetidis* discovered in the Andaman Islands), p. 269 (cirri compared with those of *O. marginata*); Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, pp. 40, 41 (compared with *O. marginata*); Crinoids of the Indian Ocean, 1912, pp. 30, 31, 34, 39 (identity of previous records), p. 175 (synonymy; summary of previous records; remarks on the type specimens of *adeonae* and *bidens*).—Reichensperger, Abh. Senck. naturf. Ges., vol. 35, No. 1, 1913, p. 82 (Aru Islands), p. 105 (localities in detail; notes).—Gislén, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 3 (listed), p. 5 (stations 4, 10, 13), p. 28 (detailed description of the specimens), pl. 1, fig. 7.

Oligometra bidens A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (listed); vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*); Zool. Anz., vol. 34, No. 11/12, 1909, p. 368 (northwest Australia).—H. L. Clark, Mem. Australian Mus., vol. 4, pt. 11, 1909, p. 523 (comparison with *O.* [*Austrometra*] *thetidis*).

Oligometrides adeonae A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 37 (published references to specimens in the B.M.; localities; characters); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of the distribution in Australia); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 126 (synonymy; detailed description; station 273), fig. 6, p. 126 (cirrus), p. 275 (listed), pl. 28, figs. 107–109.—H. L. Clark, The echinoderm fauna of Torres Strait, 1921, pp. 6, 7 (history), p. 24 (range), p. 192 and following (range in Australia).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 51 (obliquity of the brachials), p. 79 (syzygies), p. 275, fig. 75, p. 81 (syzygial face), fig. 102, p. 87 (synarthrial face), figs. 162–164, p. 98 (pinnule articulations).—A. H. Clark, Temminckia, vol. 1, 1936, p. 308.—H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 40 (False Cape Bossut; Broome; notes); Echinoderm funa of Australia, 1946, p. 50 (Australian localities; color).

Oligemetrides adeonae Gislén, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 28 (editorial error).

Oligometra adeonae form *scabra* Gislén, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 30 (in text; characters; Mjoberg's Station 4), p. 31 (specimens 10 and 12 from station 10).

Description.—The centrodorsal is small, discoidal, with the dorsal pole papillose, from 1.5 to 2.0 mm. in diameter. The cirrus sockets are arranged in one and a partial second marginal rows.

The cirri are XVI, 20, about 10 mm. long. From the third, fourth, or fifth onward the cirrus segments are about as long as broad. On the fourth or fifth and following segments two transverse ridges, a proximal and a distal, are developed which in lateral view appear as two small dorsal spines.

The elements of the IBr series and the first two brachials are broad, and are in close lateral apposition all along their edges. The IBr series and arm bases of this species are most strikingly similar to those of the species of *Tropiometra*.

The 10 arms are about 50 mm. long. The first two brachials are broad and are in close apposition with those on adjacent arms. P_1 is the longest and stoutest pinnule, 8 mm. long with 13 segments of which the first is slightly broader than long, the second is trapezoidal, tapering distally, slightly longer than the proximal (greater) width, the third is about twice as long as the proximal width, the fourth and fifth are about three times as long as broad, and the remainder are from two to two and one-half times as long as broad. The pinnule tapers evenly from the base to the tip, and is distinctly prismatic, with the dorsal ridge rounded, for its entire length. P_2 is 6.5 mm. long with 12 segments, similar to P_1 but proportionately less stout. P_3 is 5.5 mm. long with 10 segments, and is similar to P_2. These three pinnules are considerably stiffened. P_4 is 4 mm. long with 12 segments of which the first is over twice as broad as long and those following gradually increase in length, becoming about as long as broad on the fourth and twice as long as broad distally. The pinnule is slightly less stout basally than P_3 and tapers more rapidly. It is weak and not stiffened. The following pinnules have more numerous and shorter segments. P_{10} is 4.5 mm. long with 17 segments which at first are short, becoming about as long as broad on the ninth or tenth. The distal pinnules are very slender, about 4.5 mm. long with 17 segments.

The color in alcohol is violet as far as about the sixth brachial, thence yellow with a narrow median line of white; the outer half or two-thirds of the proximal pinnules is yellow.

The specimen described is the most perfect example from *Siboga* station 273.

An individual similar to the preceding, with arms 50 mm. long and cirri 11 mm. long, is olive-brown, gradually becoming yellow-brown after the second syzygy. There is a narrow median line of white on the arm bases as far as the second syzygy.

Another specimen is entirely deep violet with the ends of the cirri and pinnules yellowish. A fourth example is deep purple with narrow yellow bands on the arms and a more or less obsolete narrow mediodorsal line of yellow on the arm bases. A fifth is purple with large white blotches on the arms and a fine white mediodorsal line. Still another is entirely orange-yellow. The remaining two specimens from *Siboga* station 273 resemble one or other of those preceding.

Notes.—Professor Bell said that in the specimens from Port Curtis and Port Denison a white line which extends along the middle of the IBr series, the rest of which is of a reddish purple, is continued for a short, though varying distance along each of the arms.

In the specimen from *Alert* station 87 the cirri are about XX, 21. The transverse ridge has moved so far back that it is near the proximal end of the cirrus segments, and the distal dorsal border of the segments has become prominent so that the bidentate appearance, in lateral view, is produced.

The 10 arms are 65 mm. long. P_1 is the longest pinnule, and is stiffened. P_2 is similar, but slightly shorter. P_3 is similar, but is slightly shorter than P_2. The ends of the segments of these proximal pinnules tend to be slightly prominent.

The general appearance of the animal is strikingly like that of *Tropiometra carinata.*

Prof. F. Jeffrey Bell described *Antedon bidens* from Torres Straits as follows:

> Centrodorsal prominent: about 20 cirri, with about 20 joints, a number of which have two minute processes on their dorsal side; the penultimate spine is small; none of the joints are distinctly longer than broad, but a number of them have a shallow lateral excavation along their distal edge.
>
> First radials just visible; second very wide, in contact; third almost triangular, not quite twice as long as the second, and forming a convex protuberance with it. Ten arms. First brachials in contact, a little wider on their outer than their inner side, as are also the second brachials, which form with the first a convex protuberance; the third brachials, which are syzygies, have a sharp distal edge, as have the succeeding joints; these soon become wedge-shaped, and form a strong overlap on either side alternately; after some time this diminishes, and the more terminal joints of the arm form rather bead-like swellings on either side.
>
> Syzygies 3, 9, 14; 4–6 joints between the succeeding syzygies.
>
> The first pinnule is very stiff and long, with the most proximal joint the longest; it is placed on the second brachial, has some 12 joints, of which the more basal are much longer than broad, and which are also stouter than those on the sixth brachial, which, again, are a little stouter than those on the fourth. The pinnules then gradually diminish in size, and then again increase further out.
>
> The arms are stiff, and somewhat compressed from side to side; they are about 45 mm. long; diameter of disk 5 millim., of centrodorsal 3.3; length of cirri about 8 millim.
>
> The original colour was probably purple.
>
> Torres Straits.

I examined Bell's specimens of *Antedon bidens* at the British Museum in 1910. They represent the same species as the types of Lamarck's *Comatula adeonae.* In the best specimen obtained by the *Alert* the cirri are about XX, 21. The bidentate appearance is caused by the moving back of the transverse ridge so far that it is near the proximal ends of the segments, while the distal dorsal edge of the segments has become prominent, so that there are in effect two transverse ridges, appearing as two small spines in lateral view.

P_1 is the longest pinnule, and is considerably stiffened. P_2 is similar, but slightly shorter. P_3 is similar, but slightly shorter than P_2. The distal ends of the segments of these lower pinnules tend to become slightly prominent.

This specimen is similar to that from *Alert* station 87 described above.

Prof. Ludwig Döderlein recorded and gave notes on several specimens from Thursday Island:

He said that the dorsal pole of the centrodorsal is tuberculated

The cirri are about XX, 20–22, up to 12 mm. long. The proximal segments are cylindrical, and the distal are strongly compressed. The five basal segments are somewhat broader than long, and the remainder are as long as broad. From about the fourth onward each segment bears dorsally a transverse furrow that extends somewhat on to the sides. As a result of this furrow each segment when seen from the side appears to possess two dorsal tubercles or points, which are very characteristic of this species. The opposing spine is weak. The terminal claw is moderately strongly curved.

The radials are just visible. The IBr_1 are very broad, and are in lateral contact.

The IBr_2 (axillaries) are pentagonal with the lateral border shorter than that of the IBr_1. A strong synarthrial tubercle is present on the IBr series.

The 10 arms are about 50 mm. long in one specimen. The first brachials are in contact. There is a strong synarthrial tubercle on the articulation between the first two brachials. From the third to about the seventh each brachial forms with the following on the distal edge dorsally a laterally placed tubercle, succeeding tubercles alternating in position. The following brachials are wedge-shaped, and are provided dorsally on the distal border with alternating sharp angles which on the outer brachials gradually become blunt.

The first syzygy is between brachials 3+4, the second is between about brachials 9+10, and the distal intersyzygial interval is, with fair regularity, 4 or 5 muscular articulations.

The three lowest pinnules on either side of the arm are very similar. They are slender, stiff, and sharp with elongated segments, but with a very broad base and prominent angles on the dorsal side. P_1 is about 8 mm. long and is composed of about 12 segments. P_2 is slightly shorter and is composed of about 10 segments. P_3 is markedly shorter and, like P_2, is composed of about 10 segments. The first segment of all these pinnules is very broad, markedly broader than long. The second segment is not broader than long. The third is somewhat longer, but somewhat more slender than those preceding. The succeeding segments progressively decrease in width, though only slowly in length. P_4 is only 4 mm. long; its component segments are all broader than long. From P_6 onward the pinnules acquire a markedly larger number of segments, about 18, and those in the proximal half are about equally broad. In these, the genital pinnules, which are markedly thicker than the first pinnules and longer than P_4, the ambulacral surface shows a very prominent calcareous plating that consists of plates arranged more or less regularly in rows on both sides of the ambulacral groove.

The disk is naked and is about 7 mm. in diameter.

The color is whitish. From the IBr_1 there run outward on the dorsal side of the axillaries and for some distance along the arms two pale purple stripes; a bowed line of similar color occurs in the interambulacral areas of the disk, while the anal tube is marked with a number of almost black narrow longitudinal stripes.

Döderlein said it cannot be doubted that these specimens represent *Antedon bidens*, which was described by Bell from Torres Strait. He remarked that the single essential difference between his specimens and Bell's description and figure is that Bell gives all the segments of the lowest pinnules as much longer than broad, while in his specimens this is the case only from the third segment onward. Döderlein remarked that Carpenter did not place *Antedon bidens* in any of this specific groups, but listed it among the unclassified species at the end of his discussion of the several groups including 10-armed species of *Antedon*. He said that this species might well be looked for under the *Tenella* group, perhaps also under the *Acoela* group because of the plating of the pinnules. He remarked that he had been unable to discover any close relationship between *Antedon bidens* and any of the species in these groups.

A very small specimen with arms only 8 mm. long collected by the *Gazelle* in northwestern Australia appears to belong to this species as redescribed by Professor Döderlein, but it is so small that positive identification is not possible.

On the basis of 15 specimens from Mjöberg's stations 4, 10, and 13 Dr. Torsten Gislén redescribed *adeonae* as follows:

The centrodorsal is discoidal to hemispherical, the bare dorsal pole a little convex with small pits and knots, 2.5 mm. in diameter. The cirri are arranged in two rows.

The cirri are XIX–XXXV, 19–32 (22–32 in the upper and 19–29 in the lower row), about 12 mm. long. The first segment is short. The four following are broader than long, and those succeeding are about as long as broad, or a little longer than broad. The penultimate segment is shorter again. The outer segments are provided with two groups of processes, a proximal transverse ridge and a distal row of spines. The proximal transverse ridge is straight and even, and is situated at the proximal border of the segment. The distal transverse ridge is situated on the distal part of the segment and is somewhat curved with irregular protuberances at the margin; on the distal segments these are prolonged into two blunt lateral spines. The proximal transverse ridge usually appears somewhat before the distal one. The distal borders of the segments on their ventral side are bent a little outward, which gives the cirri a somewhat uneven margin. The opposing spine occupies only a portion of the dorsal surface of the penultimate segment, and reaches a height equal to one-third the width of the segment. The proximal transverse ridge often still remains on the penultimate segment. The terminal claw is stout, strongly curved, and about as long as the penultimate segment. Fully developed cirri usually show the proximal transverse ridge on about the fifth and the distal on the eighth-thirteenth segments. The dorsal processes are developed first on the proximal segments, and last of all on the distal ones.

The radials are visible as narrow bands, or are concealed by the centrodorsal except in the interradial angles of the calyx. The median portion has one or more distinct tubercles, and similar tubercles are often found on the proximal portion of the IBr_1. The IBr_1 are three times as broad as long, and are united in their basal halves. With the IBr_2 (axillaries) they form a synarthrial tubercle which is separated from the remaining portion of the ossicles by shallow grooves. The distal angle of the IBr_2 is less than 90°.

The 10 arms are 50–70 mm. long. The first brachials are interiorly united basally, and form a synarthrial tubercle with the second. The ossicles from the IBr_1 to the second brachials have ventrolateral flanges that encircle a narrow U-shaped gap between the arms. The fourth-ninth brachials have prominent and swollen distal borders. The prominence on the fourth brachial is most strongly developed interiorly, so that there is a prominence directed backward alternately on the exterior and interior of the arm. In addition, on these segments proximally developed tubercles often form an indistinct median ridge. After the second syzygy the brachials grow smoother and are wedge-shaped.

The first syzygy is between brachials 3+4, and the second is from the eighth to the eleventh segment. The distal intersyzygial interval is 4 muscular articulations, syzygies occurring, for instance, between brachials 9+10, 14+15, 19+20, etc.

P_1 is from 10 to 15 mm. long with 13–20 segments. The first segment is about as long as broad, the second is half again as long as broad, and the third, fourth, and fifth are more than twice as long as broad; the segments following are shorter again, always, however, a little longer than broad. The pinnule is smooth, strongly compressed laterally like those following, and directed stiffly upward. P_2 is from 9 to 14 mm. long with 13–19 segments of which the fourth is the longest, and resembles P_1. P_3 is from 7 to 12.5 mm. long with 13–17 segments. P_4 is from 6 to 10.5 mm. long with 13–22 segments which are shorter than those of the pinnules preceding, never more than one-quarter again as long as broad. P_5, P_6, and P_7 are similar, but with the segments still shorter and increasing in number. P_{15} is 7 mm. long with 24 segments. The distal pinnules are from 7 to 10 mm. long with 21–25 segments of which the first two are a little swollen, and the others are very thin and slender. P_a corresponds approximately with P_1, P_b corresponds to P_2, etc.

The mouth is somewhat displaced laterally. The anus is subcentral. The peristome has calcareous granules.

The color is dark red (in alcohol deep red-brown), with the oral pinnules often tipped with white.

In one of the specimens from Mjöberg's station 13 (Broome) the cirri are XXX (with one small), 19–28 (those in the distal row about the dorsal pole with 19–24, and those in the proximal row about the rim of the centrodorsal with 25–28 segments). In a cirrus from the distal row with 19 segments the proximal dorsal transverse ridge begins on the fourth and the distal on the eighth segment. In another from the same row with 24 segments the proximal ridge begins on the eighth and the distal on the eleventh segment. In a cirrus from the proximal row with 28 segments the proximal ridge begins on the third and the distal on the eighth segment; the six outermost segments are smooth dorsally.

In another specimen from the same station the cirri are XXVIII (with one small), 20–25 (the proximal with 23–25 and the apical with 20 or 21 segments). In a cirrus from the apical row with 20 segments the proximal ridge begins on the fifth and the distal on the ninth. In another cirrus from the same row with 21 segments the proximal ridge begins on the fourth and the distal on the eighth. In a third cirrus from the same row with 21 segments the proximal ridge begins on the fifth and the distal on the fifteenth segment, the latter being only slightly developed. P_1 is 15 mm. long with 20 segments. P_2 is 14 mm. long with 19 segments. P_3 is 12.5 mm. long with 17 segments. P_4 is 10.5 mm. long with 18 segments. P_5 is 12.5 mm. long with 21 segments. P_a is 15 mm. long with 19–21 segments. P_b is 12.5 mm. long with 16 segments. P_c is 11 mm. long with 16 segments.

Dr. H. L. Clark said that this species is one of the commonest of the small comatulids in the Broome region, and he met with it constantly. It was particularly common and easy to collect (along with *Zygometra comata*) at the extremely low September tides in 1929 on the hard sand bottom of Roebuck Bay. His field notes read: "Very lovely; deep red purple, with or without white." "Sometimes apparently deep yellow, with or without white on basal pinnules." He said that alcoholic specimens keep their color very well. Dry specimens are duller and show no white, but instead are various shades of yellow and pale brown. Practically all gradations may be found between the purple and yellow individuals.

His largest specimens have arms about 90 mm. long, and the cirri are XXX–XXXII, 28–30 while the smallest individuals have arms about 35 mm. long and the cirri XVI–XIX, 16–21.

Dr. Clark said that the most interesting specimen was one with 11 arms, a single

IIBr 2 series being present. There are no other notable peculiarities, except, perhaps, that it is the most conspicuously yellow of all the specimens preserved. Another notable specimen with the arms 75–80 mm. long has one arm that gives off a branch almost at right angles in the vicinity of the eighteenth brachial; just one or two brachials farther on the main arm forks and three brachials farther the left arm forks again. He brought back in all 61 specimens.

In a specimen from Mjöberg's station 4 the arms are 65 mm. long. The cirri are XXXIV (of which seven are small), 24–30. In a cirrus from the apical row with 24 segments both the proximal and distal ridges begin on the eighteenth. In another cirrus with 24 segments from the same row the proximal ridge begins on the fourth and the distal on the sixteenth. In a third cirrus from the same row with 27 segments the proximal ridge begins on the fourth and the distal on the sixteenth. In a cirrus from the proximal row with 27 segments the proximal ridge begins on the twelfth and the distal on the fifteenth. In another cirrus from the proximal row with 29 segments the proximal ridge begins on the eighth and the distal on the eleventh segment. In a young cirrus with 30 segments only the proximal ridge is developed, occurring from the third to the twelfth segments. P_1 is 12.5 mm. long with 17 segments. P_2 is 12 mm. long with 17 segments. P_3 is 11.5 mm. long with 17 segments. P_4 is 9.5 mm. long with 22 segments. P_5 has 24 segments. P_{13} is 9 mm. long with 26 segments. P_a is 12.5 mm. long with 17 segments. P_b has 16 segments, and P_d has 21 segments.

In another specimen from Mjöberg's station 4 the arms are 65 mm. long. The cirri are XXXIV (of which four are small), 17–25+. The cirri of the apical row have 17–22, and of the proximal row 23–25+ segments; on the latter the proximal ridge begins on the fifth and the distal on the thirteenth segment. P_1 is 14 mm. long with 16–18 segments. P_2 is 12.5 mm. long with 15+ segments. P_3 has 13+ segments. P_4 has 19+ segments. P_5 is 9 mm. long with 21 segments. P_a has 15+ segments. P_b is 11.5 mm. long with 15 segments. P_c is 10 mm. long with 15 segments.

In a third specimen from Mjöberg's station 4 the arms are 70 mm. long. The cirri are XXXV (of which two are small), 20–26. The cirri of the apical row have 20–22 segments, and those of the proximal row 20–26. In a cirrus of the apical row with 22 segments the proximal ridge begins on the fourth, and the distal on the eighth. In a cirrus of the proximal row with 25 segments the proximal ridge begins on the fourth and the distal on the tenth. In another cirrus of the proximal row the proximal ridge begins on the fifth and the distal on the tenth. P_1 is 14 mm. long with 18 or 19 segments. P_2 is 13 mm. long with 16 or 17 segments. P_3 has 15+ segments. P_5 has 22 segments. P_a is 13 mm. long with 16+ segments. P_b is 12 mm. long with 15+ segments. P_d has 25 segments.

In a fourth specimen from Mjöberg's station 4 the arms are about 65 mm. long. The cirri are XXXII, 18–26. The cirri in the apical row have 18–23 segments, and those in the proximal row 22–26. In a cirrus from the apical row with 22 segments the proximal ridge begins on the fourth and the distal on the fifteenth. In a cirrus from the proximal row with 22+ segments the proximal ridge begins on the fifth and the distal on the tenth. P_1 is 12.5 mm. long with 17 segments. P_2 is 13 mm. long with 18 segments. P_3 is 11 mm. long with 17 segments. P_4 is 9.5 mm. long with 15 segments. P_a is 12.5 mm. long with 18 segments.

In the specimen from Mjöberg's station 10 the arms are 55 mm. long. The cirri are XIX, 20–25. The cirri in the apical row have 20–23 and those in the proximal row 23–25 segments. In a cirrus from the apical row with 20 segments the proximal ridge begins on the fourth and the distal on the eighth. In another cirrus from the same row with 20 segments the proximal ridge begins on the fifth and the distal on the fourth. In a cirrus from the proximal row with 23 segments the proximal ridge begins on the fifth and the distal on the fourth. P_1 is 9.5 mm. long with 15–16 segments. P_2 is 9 mm. long with 15 segments. P_3 is 7 mm. long with 13 segments. P_4 is 6.5 mm. long with 18 segments. P_a is 9.5 mm. long with 14 segments. P_b is 8.5 mm. long with 14 segments.

In a second specimen from Mjöberg's station 10 the arms are 50 mm. long. The cirri are XXII, 19–27, those in the proximal row having 25–27 segments. P_1 has 15 or 16 segments. P_2 is 11 mm. long with 14 or 15 segments. P_3 has 11+ segments. P_4 has 16 segments. P_b has 14 and P_d 16 segments.

In a third specimen from station 10 the arms are 60 mm. long. The cirri are XXXI (six empty sockets and three young regenerating cirri), 22–26, those in the apical row having 22–26 and those in the proximal row 24–26 segments. In a cirrus in the apical row with 26 segments the proximal ridge begins on the fifth and the distal on the eighth. In a cirrus in the proximal row with 25 segments the proximal ridge begins on the fifth and the distal on the thirteenth. In another cirrus in the proximal row with 25 segments the proximal ridge begins on the fourth and the distal on the sixth. In a third cirrus from the proximal row with 25 segments both the proximal and distal ridges begin on the fifth. P_1, regenerating from the eighth segment, is 10 mm. long with 14 segments. P_2 is 9 mm. long with 13 segments. P_4 is 8.5 mm. long with 19 segments. P_5 is 7 mm. long with 18 segments. P_6 is 9 mm. long with 25 segments. P_a is 9 mm. long with 12 segments. P_b is 8 mm. long with 12 segments. P_c is 8 mm. long with 14 segments. P_f is 9 mm. long with 22 segments.

In a fourth specimen from station 10 the arms are about 60 mm. long. The cirri are XXIV (two being small), 21–27, those in the apical row having 21–24, and those in the proximal row 25–27 segments. In the cirri of the apical row there are no dorsal spines, or only slightly indicated ones on some few segments from about the eighteenth. In a cirrus of the proximal row with 27 segments the proximal ridge begins on the seventh and the distal on the thirteenth. P_1 is about 11 mm. long with 17 segments. P_2 is of about the same length with 15 segments. P_3 is shorter with 14 segments. P_a is 11.5 mm. long with 16 segments. P_b is 10 mm. long with 14 segments. P_d is 7 mm. long with 17 segments.

In a fifth specimen from station 10 the arms are 60 mm. long. The cirri are XXIII, 21–28, those about the dorsal pole having 21–25 and those about the rim of the centrodorsal 23–28 segments. The cirri are, as described by Gislén, in a single row, but their places of attachment usually correspond to an apical and a proximal row. Five regenerating cirri are included in the number given. In a cirrus from the apical row with 24 segments the proximal ridge begins on the sixth and the distal on the tenth. In another from the same row with 25 segments the proximal ridge begins on the fourth and the distal on the tenth. In a cirrus from the proximal row with 23 segments the proximal ridge begins on the fourth and the distal on the ninth. In another from the same row with 25 segments the proximal ridge begins on the second and the distal on the eleventh. P_1 is 10 mm. long with 13 segments. P_2 is

9 mm. long and with 14 segments. P_3 is 8 mm. long with 14 segments. P_4 is 6 mm. long with 13 segments. P_5 is 6 mm. long with 15 segments. P_9 is 7 mm. long with 19 segments. P_a is 9 mm. long with 14 segments. P_b is 8 mm. long with 13 segments. P_d is 6 mm. long with 14 segments.

A sixth specimen from station 10 is of the *scabra* type with the arms 60 mm. long. The cirri are XXXI, 25–26, with the proximal ridge beginning on the fifth and the distal on the ninth segment. P_1 is 11.5 mm. long with 16 segments. P_2 is 10 mm. long with 16 segments. P_3 is 9 mm. long with 14 segments. P_5 is 8 mm. long with 19 segments. P_a and P_b have 12+ segments.

In a seventh specimen from station 10 the cirri are XXVII, 24–32, those in the apical row having 24–29 and those in the proximal row 25–32 segments. P_1 is 11 mm. long with 15 segments. P_3 has 14 segments. P_a has 15 segments. P_c has 15 segments. P_d has 19 segments.

An eighth specimen from station 10 is of the *scabra* type with the arms about 70 mm. long. The cirri are XXIV (of which two are small), 19–28, those in the apical row having 19–21 and those in the proximal row 22–28 segments, the cirrus with 28 segments being young. In a cirrus from the proximal row with 22 segments the proximal ridge begins on the fifth and the distal on the eighth. P_1 is 10 mm. long with 15 segments. P_2 is 9.5 mm. long with 14 segments. P_4 is 7 mm. long with 15 segments. P_a has 14 segments. P_b has 14 segments, of which the distal are provided with slight distal prominences, and is 10 mm. long.

A ninth specimen from station 10 has the cirri XXV, 19–25, those in the apical row having 19–22 and those in the proximal row 23–25 segments. In a cirrus from the apical row with 22 segments the proximal ridge begins on the third and the distal on the seventh. In a cirrus from the proximal row with 24 segments the proximal ridge begins on the fourth and the distal on the sixth. P_1 is 14 mm. long with 20 segments. P_2 has 18 segments. P_3 is 11 mm. long with 17 segments. P_4 has 20 segments. P_5 has 21 segments. P_c is 10.5 mm. long with 18 segments. P_g is 10 mm. long with 24 segments.

In the type specimens of Lamarck's *Comatula adeonae*, which I examined at the Paris Museum in 1910, the cirri are about XXX, 17–20 (most commonly 19), and are very stout. The first segment is very short and those following gradually increase in length, becoming nearly as long as broad on the sixth and following. The fourth and following have on the dorsal surface two transverse ridges which appear as two small spines in lateral view.

The division series and first three brachials resemble those of the species of *Tropiometra* in being very broad and sharply flattened against their neighbors laterally. There is considerably more flattening than in the species of *Tropiometra*, as the plates are deeper dorsoventrally. The four brachials following the first syzygial pair are oblong and very short. The succeeding brachials are triangular, soon becoming about as long as broad.

The proximal pinnules are large and strongly prismatic. P_1 is the largest and longest, and is composed of 8–10 segments, of which the third and fourth are the largest and longest. The length, size, and stoutness of the pinnules gradually decrease to P_5 or P_6. The distal pinnules are not much longer than P_6.

The three small specimens from off Wardakau, Sungi Barki, as described by

Reichensperger, are very defective, all the arms apparently being in process of regeneration. The color in alcohol is whitish, with the cirri and proximal portion of the arms somewhat red brown.

Of the two specimens from the Western Channel of Sungi Barki one is much broken. The arm length is about 40 mm. The cirri are about XXV, 19–20.

The two large specimens from off Lola have an arm length of 50–60 mm., and the cirri are about XX, 19. P_1 has about 9–12 segments. P_2 has about 10 segments. The color is dark red.

The smallest specimen secured by Doctor Merton is that from off Palu Bambu, which has an arm length of 35 mm., and the cirri XVI, 18–20.

Remarks.—Dr. Torsten Gislén distinguished as form *scabra* the specimens from Mjöberg's station 4. All these specimens present segments of a more or less rough appearance, and the arms feel scabrous. The median dorsal prominences on the proximal segments are less developed than usual. The basal portions of the arms have the lateral processes more perfected, so that they appear more strongly "wall-sided" than is usually the case.

Dr. Gislén said that the conclusion to be drawn from his study of the specimens collected by Dr. Mjöberg is that the number of cirri and cirrus segments, the length of the proximal pinnules, and the number of the segments is in these pinnules are all features with rather great variability. It is fairly certain that they vary at different ages, and that the figures of variability would have been still larger if the available specimens had been more unequal in size.

Gislén said that the number of the cirri varies between XIX and XXXV. As to their distribution on the centrodorsal, we can distinguish more or less distinctly two categories—an inner dorsal row about the dorsal pole, in which the cirri have as a rule a smaller number of segments, and an outer row about the periphery of the centrodorsal in which the cirri have a greater number of segments. Gislén remarked that this is probably a usual phenomenon, evidently correlated with the fact that the animal is still growing, and also that new cirri are formed at the radials on the border of the centrodorsal.

Gislén remarked that the younger cirri are therefore to be found in the peripheral row, and if it is true that the number of cirrus segments increases during the growth of the animal it is obvious that the older cirri, in the row about the dorsal pole, ought to have fewer, and the younger, in the peripheral row, ought to have more segments.

Though the proximal pinnules vary both in length and in the number of their component segments, the relative length of P_1, P_2, and P_3 is nevertheless uniform. The number of segments in P_1 varies between 13 and 20, and the length of this pinnule between 10 and 15 mm. P_2 is composed of from 13 to 19 segments, and is from 9 to 14 mm. long. P_3 is shorter and usually has fewer segments. In the pinnules following the length either does not increase at all, or increases only very slowly, but the number of the component segments through the shortening of the segments rises rapidly to the number (20–25) in the distal pinnules. Gislén noted that the appearance and proportions of corresponding pinnule segments are rather closely similar in the specimens described. But there are distinct, though small, distal prominences on the segments of P_b in the eighth specimen described from station 10. Gislén emphasized the fact that all the specimens examined by him were of about the same size, and he was not sure that younger specimens will not show different proportions.

Localities.—*Alert*; Port Curtis, Queensland [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1912].

Alert; Port Denison, Queensland [Bell, 1884, 1888; P. H. Carpenter, 1888; A. H. Clark, 1911, 1912].

Alert station 87 [A. H. Clark, 1913] (1, B. M.).

Queensland [A. H. Clark, 1912]. This refers to the preceding localities.

Northern Australia [A. H. Clark, 1912]. This refers to the previous localities from this region.

Alert; Torres Strait; 18 meters; sand [Bell, 1884, 1888; P. H. Carpenter, 1888; A. H. Clark, 1907, 1911, 1912, 1913, 1921] (1, B. M.).

Thursday Island; Prof. R. Semon [Döderlein, 1898; A. H. Clark, 1911, 1912].

Alert; Dundas Strait, between the Coburg peninsula and Melville Island [Bell, 1884; A. H. Clark, 1911, 1913] (1, B. M.).

Baudin Island; 15–27 meters [A. H. Clark, 1911, 1912] (1, B. M.).

Gazelle; northwestern Australia [A. H. Clark, 1909, 1911, 1912] (1, Berl. M.).

Mjöberg's station 13; Broome, Roebuck Bay, Western Australia; from the beach at low tide; July 27, 1911 [Gislén, 1919].

Broome; H. L. Clark, August and September, 1929, and June 1932 [H. L. Clark, 1938].

False Cape Bossut; H. L. Clark, September 1929 [H. L. Clark, 1938].

Mjöberg's station 4; Cape Jaubert (about 75 miles southwest of Broome) 45 miles west-southwest; 22 meters; July 2, 1911 [Gislén, 1919].

Mjöberg's station 10; Cape Jaubert 45 miles west-southwest; 20 meters; July 16, 1911 [Gislén, 1919].

Australia; MM. Péron and Lesueur, 1803 [Lamarck, 1816, 1837; de Blainville, 1818, 1830, 1836; Lamouroux, 1824; (Anonymous), 1837; Deshayes and Milne-Edwards, 1840; J. Müller, 1841, 1843, 1849; Dujardin and Hupé, 1862; W. B. Carpenter, 1866; (Knight), 1867; P. H. Carpenter, 1879, 1883, 1888; Bell, 1882, 1884; A. H. Clark, 1907, 1908, 1909, 1911, 1912, 1913; H. L. Clark, 1909, 1921] (1, P. M.).

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands; pearl banks; 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (8, U. S. N. M., E. 441; Amsterdam Mus.).

Off Wardakau, Sungi Barkai, Aru Islands; 12 meters; coral rock and sand; Dr. H. Merton, April 16, 1908 [Reichensperger, 1913].

Western channel, Sungi Barkai, Aru Islands; 15 meters; rocky bottom; Dr. H. Merton, April 9, 1908 [Reichensperger, 1913].

Off Lola, northern Penambulai, Aru Islands; 5 meters; Dr. H. Merton [Reichensperger, 1913].

Off Pulu Bambu, Aru Islands; 10 meters; rocky bottom with sand and coral; Dr. H. Merton, April 3, 1908 [Reichensperger, 1913].

Geographical range.—Northern Australia south to Port Curtis, Queensland, and Cape Jaubert, Western Australia, and the Aru Islands.

Bathymetrical range.—From between tide marks down to 22 (?27) meters.

Parasite.—Gislén noted that two of the specimens from Mjöberg's station 10 were parasitized by a species of *Eulima* (=*Sabinella* sp.; see Part 2, pp. 648–649). He said that Dr. Nils Odhner, of Stockholm, to whom he submitted the specimens for determination, kindly gave him the following statement.

The largest specimen, attached to the centrodorsal of a specimen of *Oligometrides adeonae*, is 1.5×0.7 mm., and has nearly 8 turns. It is possibly identical with *Eulima capillastericola* of Bartsch, but as the description of this species does not contain anything especially characteristic and is not accompanied by any plate, it cannot with certainty be identified—the less so as even full-grown species of the genus *Eulima* are extremely difficult to determine on account of their slightly characteristic exterior and the absence of a radula.

History.—This species was first described by Lamarck as *Comatula adeonae* in 1816 from specimens that had been collected in Australia in 1803 by François Péron and Charles Alexandre Lesueur during the expedition of the *Geographe* and *Naturaliste* commanded by Capt. Nicolas Baudin. The species was named *adeonae* because it was often found attached in large numbers to the broad foliaceous expansions of the polyzoan *Adeona*. Lamarck's original description was republished by Henri Marie Ducrotay de Blainville in 1818, by Jean Vincent Félix Lamouroux in 1824, and again by de Blainville in 1830. In 1836 de Blainville republished Lamarck's description, and by a curious error illustrated the species by a reproduction of the figure of *Comatula multiradiata* (=*Heterometra savignyi*) published by Savigny in 1817 (1826). Lamarck's description was republished in the third edition of his work in 1837. In the Penny Encyclopedia in 1837 the redescription of *Comatula adeonae* published by de Blainville in 1836, together with Savigny's figure of *Comatula multiradiata* (=*Heterometra savignyi*), was included. Lamarck's original description again appeared in the second edition of his work edited by Gerard Paul Deshayes and Henri Milne Edwards and published in 1840.

In 1841 Prof. Johannes Müller included *Alecto adeonae* (*Comatula adeonae* Lam. Blainv. *Actinol.* Tab. XXVI) in a list of previously noticed, but mostly incompletely described, 10-armed species of comatulids.

In 1843 Müller redescribed *Alecto adeonae* on the basis of notes made by Dr. Franz Herrmann Troschel on the type specimens in the Paris Museum. His redescription was as follows:

> 10 Arme. 20 Ranken am Knopf, aus 20 Gliedern bestehend, deren vorletztes nach innen einen kleinen Dorn tragt. 3 Glieder der Radien. Diese so wie die nächst folgenden Glieder sind breit und bilden zwei scharfe Kanten. Über dem radiale axillare hat das dritte Glied das erste Syzygium. Weiterhin 3–5 Glieder zwischen den Syzygien der Arme. Die Pinnulae an den Armen sind alle lang, die ersten 3–4 aber die längsten. Grösse 4 Zoll.
>
> Neuholland.

In his monograph on the comatulids published in 1849 Müller republished verbatim this redescription, adding that the specimens were in the Paris Museum and had been collected by Péron, but omitting the locality.

It is rather curious that in 1841 and again in 1849 Müller referred to de Blainville, 1836, including a definite mention of the figure of *Comatula multiradiata*, but made no comment on the fact that it represents a multiradiate and not a 10-armed species.

In the monograph on the echinoderms written by Félix Dujardin and completed and published in 1862, two years after his death, by L. H. Hupé, *Comatula adeonae* is described by a translation of the redescription published by Müller in 1843, the only emendation being in the size, which is given as 80-100 mm. (expanse). To the description a note was added which says that the species is from the seas of Australia (Nouvelle-Hollande) where it is often found attached in large numbers to the broad foliaceous expansions of the polyzoan *Adeona*.

In 1866 Dr. William Benjamin Carpenter remarked that this species is quite distinct from Delle Chiaje's *Comatula adeonae*, which is *Antedon rosaceus* (=*mediterranea*).

In his Natural History published in 1867 Knight included the account of *Comatula adeonae* given in the Penny Encyclopedia in 1837, together with the figure of Savigny's *Comatula multiradiata*.

Dr. Philip Herbert Carpenter in the autumn of 1876 visited the Paris Museum and examined the types of *Comatula adeonae*. In 1879 he referred *adeonae* to the genus *Antedon* as understood by him—that is, as including all the comatulids not assignable to *Actinometra*.

Prof. Francis Jeffrey Bell in October 1882 proposed a specific formula for *Antedon adeonae*, which was emended by P. H. Carpenter in April 1883.

In his report upon the comatulids collected by the *Alert* published in 1884 Prof. F. Jeffrey Bell recorded *Antedon adeonae* from Port Curtis and Port Denison, and gave notes on the color of the specimens. He remarked that—

> There is a curious error in connexion with this species which does not seem to have been noticed. Lamarck described it as "*C. radiis pinnatis denis* &c;" de Blainville, while quoting Lamarck, refers also to his own figures in his 'Atlas' (pl. xxvi.); in this reference he is followed by J. Müller and by the editors of the second edition of Lamarck. The figures, however, when referred to are seen to be those of a species with twenty arms and with cirri nearer thirty than twenty. It is not perhaps necessary at this distance of time to waste time in inquiring what species it is that de Blainville has there figured.

At the same time Professor Bell described and figured a new species, *Antedon bidens*, from Torres Straits, and recorded *Antedon pinniformis* from Dundas Strait, Northwestern Australia. His specimens of *adeonae*, *bidens*, and *pinniformis* are all examples of the present species.

In his report upon the comatulids of the *Challenger* expedition published in 1888 Dr. P. H. Carpenter placed *bidens* and *adeonae* in a list of six species that according to him do not seem to fit into any of his specific groups. In the key to these six species *bidens* is said to have P_1 the largest and the cirrus segments with two dorsal spinelets whereas *adeonae* is placed under the contrasting heading "The lower pinnules tolerably equal." *Antedon adeonae* is paired with *A. laevipinna;* it is said to have "Twenty cirrus-joints without spines; syzygial interval three or four joints" whereas *laevipinna* is placed under the heading "Twenty-five to thirty-five spiny cirrus-joints; syzygial interval nine or ten joints." Carpenter gave Queensland as the habitat for *adeonae*, and Torres Straits as the habitat for *bidens*. He also accepted as correct Bell's record of *Antedon pinniformis*, giving as the habitat of this species "New Guinea; North-West Australia."

In 1888 Bell compared *Antedon bidens* with his new species *A.* (*Compsometra*) *incommoda*.

Prof. Ludwig Döderlein in 1898 described and figured several specimens of *Antedon bidens* from Thursday Island.

In my first revision of the old genus *Antedon* published in 1907 I retained *adeonae* in *Antedon* as restricted but placed *bidens* in the new genus *Himerometra.*

On the establishment of the genus *Oligometra* by me in 1908 both *adeonae* and *bidens* were referred to it, and both were included in a list of the species of *Oligometra* published in 1909. Later in 1909 *Oligometra bidens* was compared with the new species *O.* (*Decametra*) *studeri.* In comparing *O. bidens* with this new species I said that the elongate proximal pinnules described in *O. adeonae* would serve to differentiate it, if *adeonae* should be shown to really belong to the genus *Oligometra.* In a list of the crinoids collected by the German steamer *Gazelle* published in 1909 I recorded as *Oligometra bidens* a very small specimen from northwestern Australia.

In 1909 Dr. Hubert Lyman Clark compared his new species *Oligometra* (*Austrometra*) *thetidis* with *O. adeonae* and *O. bidens.* He remarked that in view of our imperfect view of *adeonae,* and the obvious resemblance between that species and both *bidens* and *thetidis,* it seemed to him quite possible that more abundant material will show that the three names belong to a single species.

In 1910 I examined the types of Lamarck's *Comatula adeonae* in Paris, very shortly after studying the type of Bell's *Antedon bidens* in London, and in 1911 published a redescription of *adeonae* and noted that it is the same as *bidens.* In my memoir on the crinoids of Australia published in 1911 I gave a synonymy of *Oligometra adeonae,* including under this species Bell's *Antedon bidens* and his specimen of *Antedon pinniformis* from Dundas Strait, Döderlein's specimens of *Antedon bidens* from Thursday Island, and the *Gazelle* specimen from northwestern Australia recorded by me as *Oligometra bidens.* In giving the differential characters of *O. adeonae,* which was compared in detail with *O.* (*Austrometra*) *thetidis,* I used the name *bidens* throughout instead of *adeonae,* because the memoir was written before I had seen the types of *adeonae* and *bidens*—at a time, therefore, when my concept of these forms was based wholly upon the available inadequate descriptions—and in recasting the paper, which was then in proof, I failed to change *bidens* to *adeonae.* A redescription of the type specimens of *Comatula adeonae* was given. I remarked that Bell's figure of *bidens* is very misleading, but a good (photographic) illustration of the species was given by Döderlein.

In my report upon the crinoids of the Hamburg Southwest Australian Expedition published in 1911 I gave in detail the distribution of *Oligometra adeonae* on the Australian coasts. In 1911 also I compared the cirri of my new species *Comaster* (*Comantheria*) *taviana* with those of *Oligometra adeonae.*

In my memoir on the crinoids of the Indian Ocean published in 1912 I gave a short synonymy of *Oligometra adeonae,* including under this species Bell's *Antedon bidens,* and listed the localities where the species had been obtained including, as in 1911, Baudin Island from where I had seen a specimen in the British Museum in 1910. I remarked that an examination of the types of *Comatula adeonae* at Paris and of *Antedon bidens* at the British Museum had shown that in reality the two are the same species. The *Alert* collection contains specimens identified both as *Antedon adeonae* and as *Antedon bidens.* The only adequate figure of the species yet published is that given by Döderlein.

In my description of *Oligometra* (*Prometra*) *intermedia* published in 1912 I compared the cirri with those of *Oligometra adeonae.* I noted that one of the items of interest brought to light by the study of a small collection of crinoids made by the *Investigator* is the discovery of a new species of *Oligometra* allied to the Australian *O. adeonae* in the Andaman Islands. I said that up to a few weeks before *O. adeonae* in north Australia and the Aru Islands and *O. thetidis* in New South Wales were supposed to represent a somewhat anomalous type of the genus peculiar to Australia; but very recently a related species, *O. marginata*, had been described from Solor Strait in the Lesser Sunda Islands, where it was dredged by the Dutch steamer *Siboga*. I said that not only does this new species greatly increase the known geographical range of this curious group, but it possesses an additional interest in being intermediate in its characters between this group within the genus *Oligometra* and the species of the genus *Prometra*, furnishing new evidence of the very close interrelationships between all the genera comprised within the family Colobometridae. In another paper published in 1912 I compared the cirri of *Oligometra adeonae* with those of *Comantheria weberi*, and in still another I compared my new species *Oligometra marginata* with *O. adeonae*.

In 1913 Dr. August Reichensperger recorded and gave notes on eight specimens of *Oligometra adeonae* from four localities in the Aru Islands, and in the same year I recorded four specimens of *Oligometrides adeonae* from four different localities which I had studied in the British Museum, including the type of Bell's *Antedon bidens* and the specimen recorded by Bell as *Antedon pinniformis*, and gave detailed notes on a specimen from *Alert* station 87. In 1915 I again discussed in detail the distribution of *Oligometrides adeonae* on the Australian coasts. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 I gave a detailed synonymy of *Oligometrides adeonae*, including under this species Bell's *Antedon bidens*, Bell's specimen from Dundas Strait recorded as *Antedon pinniformis*, my own *Oligometra marginata* described in 1912, and Dr. H. L. Clark's *Oligometra anisa*. I recorded and gave notes upon eight specimens from station 273 in the Aru Islands, and one, the type of *Oligometra marginata*, from station 305.

Dr. Torsten Gislén in 1919 recorded and gave detailed notes upon fifteen specimens of *Oligometra adeonae* that had been collected by Dr. Eric Mjöberg in northwestern Australia, and discussed the species at considerable length. He named a new form, *scabra*, giving a brief mention of its distinctive features.

Dr. Hubert Lyman Clark in 1921 noted that he had failed to find *Oligometrides adeonae* in Torres Strait but had been able to examine some specimens from the Aru Islands lent him by me, and discussed the history and distribution of the species in detail. In 1924 Dr. Gislén described at length various structural peculiarities of this species. In 1938 Dr. Clark gave an account of this species as it occurs at Broome, with brief notes on 61 specimens that he had collected at False Cape Bossut and at Broome. He said that he did not find *adeonae* at Darwin or at Cape Leveque, perhaps because the local conditions there are unfavorable.

Genus ANALCIDOMETRA A. H. Clark

Antedon (part) Pourtalès, Bull. Mus. Comp. Zool., vol. 1, No. 11, 1869, p. 356, and following authors.

Tenella group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 376.—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 394.

Oligometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126.

Analcidometra A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (*nomen nudum;* represents in the West Indies the East Indian *Stephanometra*); Mem. Australian Mus., vol. 4, 1911, p. 769 (represents *Stephanometra* in the Caribbean Sea), p. 779 (used with the specific name *caribbea* [*Oligometra caribbea* A. H. Clark, 1908]); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Stephanometra*), p. 22 (represents the Stephanometridae in the West Indies; first confused with *Oligometra* and the Caribbean species described as *O. caribbea*); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, p. 4 and following (represents *Oligometrides* in the Atlantic; range and its significance); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (Caribbean; corresponds to *Oligometrides*); Journ. Washington Acad. Sci., vol. 5, No. 1, 1915, p. 8 (most closely related to the Australian *Oligometrides;* does not occur on the eastern shores of the Atlantic); Die Crinoïden der Antarktis, 1915, p. 181 (range; represented in the Indo-Pacific by *Oligometrides*); Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 115 (most closely related to *Austrometra* and to *Oligometrides*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 111 (in key); Univ. Iowa Studies Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies), p. 18 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnosis.—A genus of Colobometridae including small species with 10 arms 15–60 mm. long in which the third-fifth segments of the genital pinnules are broadened to protect the gonads; either P_1 or P_2 is the longest and stoutest pinnule; the short and stout cirri are composed of 15–23 segments of which those in the outer half bear dorsally a prominent median spine which at first is flanked on either side by a much smaller spine, but later stands alone.

Geographical range.—From the Florida Straits and the Bahamas to Barbados and Colon.

Bathymetrical range.—From 5.5 to 64 meters.

Remarks.—This genus is closely related to *Austrometra*, differing from it most obviously in having the distal cirrus segments with a prominent median dorsal spine. In *Cotylometra* the outer cirrus segments also have a single median spine, but in that genus the cirri are longer and more slender with more than 24 segments, and the segments of the genital pinnules are not expanded.

History.—The first known species of this genus was described under the name of *Antedon armata* by Count Pourtalès in 1869. Dr. P. H. Carpenter in 1888 referred *armata* to the *Tenella* group of *Antedon.*

In 1908 in a list of species assigned to my new genus *Oligometra* there appears as a *nomen nudum* the name *Oligometra caribbea;* this species was, however, described in the following month.

In a list of West Indian and corresponding East Indian comatulid genera published by me early in 1911 the generic name *Analcidometra* appears as a West Indian type corresponding to the East Indian *Stephanometra.* Later in the same year in my memoir on the crinoids of Australia I said that *Stephanometra* is represented in the Caribbean Sea by *Analcidometra,* and later used the combination *Analcidometra caribbea,* in a footnote identifying the species as *Oligometra caribbea* A. H. Clark, 1908. In my memoir on the crinoids of the Indian Ocean published in 1912 I said that the East Indian genus *Stephanometra* corresponds to the West Indian *Analcidometra,* which represents the family Stephanometridae (now merged with the Mariametridae) in the western Atlantic. I remarked that *Analcidometra* is a curious type and was first confused with the genus *Oligometra.* The reason for erroneously referring *Analcidometra* to the family Stephanometridae was that at that time the transverse ridge on the cirrus segments had been overlooked, the dorsal processes being assumed to be single spines. This error was soon afterward detected. In a paper on the crinoid fauna of the Atlantic published in 1914 I said that *Analcidometra* represents the genus *Oligometrides* in the Atlantic, and the same statement was made in a memoir on the crinoids of West Africa published in the same year. In two papers published in 1915 I said that *Analcidometra* is most closely related to the Australian genus *Oligometrides*, and pointed out that it is confined to the western Atlantic. In 1916 I remarked that it is most closely related to *Austrometra* and to *Oligometrides*. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 *Analcidometra* is included in the key to the genera of the family Colobometridae. In this key it is paired with the genus *Austrometra*, these two genera being distinguished from the other 10-armed genera with P_a present by having the third-fifth segments of the genital pinnules expanded. *Analcidometra* is said to have P_1 much stouter than P_2 and so enlarged basally as to cause the second brachial to appear like an axillary, and the median ridge on the cirrus segments very high, whereas in *Austrometra* P_1, though longer and stouter than P_2, is not exceptionally so, and the median transverse ridge on the cirrus segments is of moderate height.

Although the genus *Analcidometra* had been frequently mentioned from 1911 on, this was the first indication of the characters by which it was distinguished from the other genera of the family Colobometridae. The characters given in the key were, however, taken from *armata* as redescribed and figured by Hartlaub in 1912 and not from the type species *caribbea* which was described before the author had seen any specimens, or an adequate description, of *armata*. After the appearance of Hartlaub's work it was assumed that *caribbea* was the young of *armata*, and not until the receipt of the 18 specimens from the *Caroline* collection in 1933 was it realized that one of the two large specimens of *armata* described by Hartlaub was in reality *caribbea*, as is shown by his figures (pl. 7, figs. 3, 4; pl. 13, fig. 7, left). In 1921 I mentioned *Analcidometra* as a genus confined to the West Indian region, and included it in a key to the genera of crinoids represented in the Caribbean Sea and adjacent waters. The characters used in this key were those of *armata* and not of *caribbea*. In a list of the crinoids of the Atlantic published in 1923 I included the genus *Analcidometra* with the single species *A. armata* and gave the range, which included the type locality of *A. caribbea*, at that time still assumed to be a synonym.

KEY TO THE SPECIES IN THE GENUS ANALCIDOMETRA

a^1. P_1 very much stouter than P_2, so much enlarged as to give the second brachial the appearance of an axillary (from the Florida Straits and the Bahamas to Barbados; 5.5-64 meters). **armata** (p. 79)

a^2. P_1 shorter and less stout than P_2, though of the same character; the lower pinnules are not greatly enlarged (from north of Puerto Rico to Colon; 62 meters) .... **caribbea** (p. 84)

ANALCIDOMETRA ARMATA (Pourtalès)

[See vol. 1, part 1, fig. 355 (cirrus), p. 293.]

Antedon armata Pourtalès, Bull. Mus. Comp. Zool., vol. 1, No. 11, 1869, p. 356 (description; west of Tortugas, 35 fms.).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (listed as an *Antedon*).—Bell, Proc. Zool. Soc. London, 1882, p. 532 (listed), p. 534 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 746 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 54, 207 (listed), p. 376

(locality).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed [in the *Tenella* group]).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (listed); pp. 394–399 (synonymy; detailed description and discussion); fig. 11, p. 397; pl. 7, figs. 1, 2, 5–7; pl. 13, fig. 7, right.

Analcidometra armata H. L. CLARK, Bull. Lab. Nat. Hist. Univ. Iowa, vol. 7, No. 5, 1918, p. 9 (Bahamas Exped. station 74).—A. H. CLARK, Univ. Iowa Studies Nat. Hist., vol. 9, No. 5, 1921, p. 8 (obtained by the Barbados-Antigua Exped.), p. 26 (station 11), p. 27 (listed); The Danish *Ingolf* Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).—H. L. CLARK, Scientific Survey of Porto Rico and the Virgin Islands, vol. 16, pt. 1, 1933, p. 8 (bathymetrical range; quoted from A. H. Clark; West Indies in less than 10 fathoms), p. 9 (in key), p. 12 (occurrence in the West Indies).

Diagnostic features.—P_1 is very stout in the basal portion, so much so as to cause the second brachial to appear as an axillary, and is very much stouter than P_2. The short stout cirri composed of segments most of which are about as long as broad, and of which the proximal bear conspicuous transverse ridges, combined with the curiously enlarged P_1, make this little species an easy one to recognize.

Description.—The centrodorsal is approximately discoidal, thin, and slightly convex. The cirri are arranged in a single marginal row.

The cirri are XIII-XV, 20 (or somewhat more), from 8 to 10 mm. long in the two larger specimens, short and more or less stout. The short cylindrical segments are of approximately equal length, and of approximately the same form; they are mostly about as long as broad, but may be slightly longer than broad, or slightly broader than long. From the second to the fifth the segments bear on the distal end dorsally a transverse ridge with several small spines; the segments following have a single median spine. The opposing spine is especially stout.

The radials are visible and are united laterally. The IBr_1 are laterally entirely free, rectangular, always markedly broader than long, in one of the two larger specimens with the distal border concave. The IBr_2 (axillaries) are more rhombic than hexagonal, as described by Pourtalès. The two proximal angles of the radials, which are often rounded off, come together in a more or less blunted angle, while the distal border is concave and runs out into acutely pointed anterolateral angles. In the smallest specimen the proximal border of the axillaries is thickened, uneven, and irregularly and sharply dentate.

The 10 arms are in the largest specimen about 45 mm. long. The first brachials are short and rather small; they are in contact only at the proximal angles. The second brachials, which are somewhat larger than the first, are often strongly axillary in shape, as a result of having on the outer side an oblique base for the very stout P_1. The first syzygial pair (composed of brachials 3+4) is markedly longer than broad. The four following brachials are approximately oblong with sharp processes on the proximal border. The brachials succeeding pass over quickly through a trapezoidal into a triangular form. The brachials of the middle arm region are longer than broad. In the middle and distal arm region small sharp processes on the distal borders of the brachials overlap the bases of the brachials succeeding. The lateral profiles of the arm as seen in dorsal view are, as a result of the humplike swelling of the brachials at the insertions of the pinnules, uneven. This is especially noticeable in the middle of the arm, so that the arms at the base often appear more slender than in the middle. All the brachials are smooth.

The first syzygy is between brachials 3+4. The position of the second syzygy is variable. In one of the large specimens it is found as a rule from between brachials 9+10 to between brachials 11+12. In the other large specimen it is sometimes between brachials 6+7 and sometimes between brachials 13+14, 14+15, or 16+17, on one arm being between brachials 20+21. So far as may be judged from the few arms preserved, the distal intersyzygial interval is 4–7 muscular articulations.

Especially characteristic is P_1, which is stiff and so stout as to influence the form of the second brachial. The only P_1 preserved on the two large specimens is 8 mm. long and is composed of 12 segments of which the first is short, the second is longer than broad, the third, fourth, and fifth are strikingly long, and those succeeding are again shorter, but still elongated. The second segment is much broader proximally than distally. Sometimes the fourth segment is extraordinarily long, though this is not at all the rule. P_a is shorter and is composed of about 7 segments which with the exception of the first are elongated and cylindrical. P_2 is of about the same length as P_1 and is composed of about the same number of segments, but lacks the strong broadening of the base. P_b is of about the same size as P_2. P_3 is sometimes markedly shorter than P_2, but sometimes of equal length; the first two segments are short and the remainder are elongated. The average number of segments is 8. The length of the segments decreases on this and the pinnules following. P_4, which is general in shorter than P_3, is composed of two short basal segments which are followed by about 5 elongated segments. From P_d the length of the pinnules and the number of their component segments again increase. The number of segments reaches about 11, of which all are shorter than those of P_1.

In the middle arm region there occur pinnules of which the segments, with the exception of the distal, as a result of lateral broadening have a thickset appearance and seem rather short. Later there are pinnules with about four short basal segments. All the pinnules, but especially the proximal, have a stiff character. No statements can be made in regard to the pinnules of the arm tips as these in the specimens at hand are all broken. The sacculi on the pinnules are numerous, large, and dark colored, as they are also on the arms. The dark color of the ambulacral side of the pinnules is due to the large number of sacculi.

The preceding description is adapted from Hartlaub's description of three much broken specimens which were sent him with the *Blake* collection after the death of Dr. P. H. Carpenter. They were without a label. One of the specimens was very small. Hartlaub said that apparently one of the three specimens was Pourtalès's type specimen, though this is not certain.

Hartlaub said that the relatively short and broad segments of the pinnules in the middle arm region are naturally excavated for the reception of the ambulacral soft parts—the genital cord, water vascular system, etc.—so that these lie rather deeply. They are only loosely attached and may easily be lifted out with a needle.

The ambulacral soft parts are broadest at the third segment, where also the dark color begins, and gradually decrease in width distally. The broad base is the result of the expansion of the genital cord into a gonad. On uninjured pinnules it may be seen that from the sides of the pinnule segments an exceedingly fine, fragile, and to all appearances continuous layer of skeletal substance extends over the ambulacral groove. In most of the cases observed by Hartlaub this fine calcareous investment was evidently broken so that he was not able to determine whether as a rule the fine calcareous membrane really passed from one side to the other or not. For the most part indefinitely bounded sheets of skeletal substance lay on both sides of the free central ambulacral groove, among which the sacculi lie uncovered, or through which they may be seen.

Hartlaub said that the disk in the two larger specimens is 6 mm. in diameter and naked and incised. In his remarks on the three specimens he said that the arm lengths were apparently 50, 45, and about 20 mm.

The color in alcohol is white and whitish gray, with the disk and ambulacral grooves brown or brownish.

Notes.—Count Pourtalès's original description was as follows:

> Ten arms; centrodorsal plate flat, rather large, bearing about fifteen cirrhi on its circumference. Cirrhi of about 20 joints, shorter than their diameter; all except the 3 or 4 first ones provided with a short spine on the concave side; last joint with a claw, and penultimate with an opposing spine. First radial protruding from the centrodorsal plate; second radial [IBr_1] nearly as long as broad; radial axial [IBr_2] pentagonal. First brachials nearly square, barely in contact by their lower corners; second brachial with a large socket for the first pinnule, which is twice as long and more than twice as thick as the second; of its 9 or 10 joints the 4th is remarkably long, forming about one fourth of the total length; the other pinnules are rather short, and are formed of the same number of cylindrical joints. Joints of the arms smooth, oblique, edges not prominent. Seven or eight joints form a syzygium.
>
> One specimen only was dredged in 35 fathoms, west of the Tortugas. The spiny cirrhi make it resemble *Antedon* (*Comatula*) *Milberti* Müller, said to be from North America, but the other characters do not agree.

Hartlaub said that Pourtalès's description of the cirri agreed with his observations on the three specimens he studied; but the IBr_1 are not "nearly as long as broad," and the IBr_2 (axillaries) are more rhombic than hexagonal [Pourtalès said pentagonal] as Pourtalès gave them.

The two specimens recorded by Dr. Hubert Lyman Clark from off Little Cat Island, Bahamas, have the arms 50 mm. long and the disk about 3 mm. across.

The specimen recorded by the author from Barbados is very small with the arms 15 mm. long.

Parasite.—On one of the two large specimens examined by Hartlaub there was a large myzostome cyst above P_1 of which the surface showed a plating of small calcareous plates.

Localities.—*Bibb* station 84P, 87P, or 88P; west of the Dry Tortugas (lat. 24°40′30″ to 24° 43′ 30″ N., long. 83° 15′ 00″ to 83° 30′ 30″ W.); 64 meters; January 16, 1869 [Pourtalès, 1869; P. H. Carpenter, 1879, 1883, 1888; Bell, 1882; Hartlaub, 1912; A. H. Clark, 1923].

Blake; Florida Straits [Carpenter, 1888; Hartlaub, 1912; A. H. Clark, 1923].

University of Iowa's Bahamas expedition station 74; off Little Cat Island, Bahamas; 5–24 meters; 1893 [H. L. Clark, 1918; A. H. Clark, 1923] (2, M. C. Z., 750; U. I. M.).

University of Iowa's Barbados-Antigua expedition station 11; Barbados [A. H. Clark, 1921, 1923] (1, U. I. M.).

No locality [Hartlaub, 1912].

Geographical range.—From the Florida Straits and the Bahamas southward to Barbados.

Bathymetrical range.—Sublittoral and down to 64 meters.

History.—This species was first described as *Antedon armata* by Count Pourtalès in 1869 from a single specimen that had been dredged by the United States Coast Survey steamer *Bibb* west of the Tortugas in 35 fathoms. Dr. P. H. Carpenter in 1879 placed *Antedon armata* in the genus *Antedon* as understood by him—that is, he determined that it was not a species of the genus *Actinometra.* In October 1882, Prof. F. Jeffrey Bell published a specific formula for *Antedon armata* which was emended by Dr. P. H. Carpenter in April of the following year. In his report upon the comatulids of the *Challenger* expedition published in 1888 Carpenter listed *Antedon armata* as a 10-armed species collected by the *Blake.* In his list of the known species of comatulids he included *armata* in the *Tenella* group, giving as the habitat the Florida Straits in 35 fathoms, and saying that it was a "species discovered by the *Blake* and other U. S. ships." He did not, however, mention in it connection with the *Tenella* group in the main body of his report.

Dr. Clemens Hartlaub in 1912 described in detail and figured three badly broken specimens, one of which was very small, that had come to him with the *Blake* collection after the death of Dr. P. H. Carpenter. There was no label with these specimens. Hartlaub pointed out that Pourtalès had described the species from a single specimen and that Carpenter had listed *Antedon armata* as a species "discovered by the *Blake* and other U. S. ships," and had also listed it as a species in the *Blake* collection. Hartlaub said that it was not certain, though it was highly probable, that one of the three specimens was Pourtalès's original type; in this case the two others would have been from the *Blake* dredgings. He noted that, curiously enough, Carpenter did not mention this species in his preliminary report upon the comatulids collected by the *Blake* (1881). Hartlaub compared *Antedon armata* in detail with *Antedon* (*Isometra*) *lineata* to which he believed it to be most closely allied. He said that the two species differ so markedly from the typical representatives of the *Tenella* group that their separation from this group is absolutely necessary. He believed that they formed a group by themselves. He remarked that among the genera that had been proposed by the author there appeared to be none capable of including them. Although there is no indication of the fact from anything that Hartlaub says, his figures show that one of the two large specimens was an example of *A. caribbea.* It is probable that Carpenter also considered this specimen as an example of *armata.* As the lower pinnules of *caribbea* are not especially enlarged, this would explain in part his reference of *armata* to the *Tenella* group, in which he was followed by Hartlaub.

In 1918 Dr. Hubert Lyman Clark recorded two specimens of *Analcidometra armata* from off Little Cat Island, Bahamas, in 3–13 fathoms where they had been collected by the Bahaman Expedition from the University of Iowa in 1893. He remarked that I had told him that *armata* is properly a member of the genus *Analcidometra,* but he could not find that the combination *Analcidometra armata* had been published hitherto.

In 1921 in my report upon the crinoids of the University of Iowa's Barbados-Antigua Expedition of 1918 I recorded a very small specimen of *Analcidometra armata* from station 11, Barbados. In a list of the crinoids of the Atlantic published in 1923 I included *Analcidometra armata* and gave its habitat and range; the locality Colon refers to the type specimen of *A. caribbea,* which at that time I considered a synonym of *armata.*

ANALCIDOMETRA CARIBBEA (A. H. Clark)

PLATE 9, FIGURE 47

Antedon armata (part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, pp. 54. 207, 376.—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 394 (one of the two larger specimens); pl. 7, figs. 3, 4; pl. 13, fig. 7, left.

Oligometra caribbea A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (listed; *nomen nudum*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 238 (description; *Albatross* station 2146); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O. studeri*); Mem. Australian Mus., vol. 4, 1911, p. 779, footnote (referred to the genus *Analcidometra*); Crinoids of the Indian Ocean, 1912, p. 22 (*O. caribbea*, type of *Analcidometra*, represents the family Stephanometridae in the western Atlantic).

Analcidometra caribbea A. H. CLARK, Mem. Australian Mus., vol. 4, 1911, p. 779 (resembles *Oligometra* [*Austrometra*] *thetidis*).

Analcidometra armata (part) A. H. CLARK, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (Colon, 64 meters; other localities and depths refer to *A. armata*).

Diagnostic features.—P_1 is shorter and less stout than P_2, though of the same character; the proximal pinnules are stiffened, but are not greatly enlarged. This little species is easily recognized by the short stout cirri composed of segments most of which are about as long as broad, and of which the proximal bear conspicuous transverse ridges, and by having P_2 the longest and stoutest of the proximal pinnules.

Description.—The centrodorsal is thick discoidal, 2 mm. in diameter, with slightly sloping sides and a slightly concave roughened or finely and sparsely papillose dorsal pole. The cirrus sockets are arranged in a single very irregular marginal row, often with obsolescent or obsolete sockets below or young cirri above the functional cirri.

The cirri are X–XV, 23, moderately stout, often tapering slightly distally. The first segment is between three and four times as broad as long, the second is about three times as broad as long, the third is about twice as broad as long, the fourth is nearly as long as broad, and those following are about as long as broad. The first segment has a single or paired tubercle or more or less broad production in the middle of the distal dorsal edge, or if there be an obsolescent cirrus socket below it, a pointed tubercle or pair of tubercles on either side on the dorsolateral margin. The second segment has the distal dorsal edge produced, the production being more or less depressed in the middle and highest laterally with the edge scalloped or coarsely dentate, or thickened and produced in the middle; there is usually a prominent pointed dorsolateral tubercle on either side. The third segment has the distal dorsal edge produced into a coarsely dentate transverse ridge terminated on either side by one or two pointed dorsolateral tubercles, or the central portion of the distal dorsal edge is thickened and raised into a broad low tubercle. On the fourth segment the dorsal distal edge may be raised into a transverse ridge as on the third, or the transverse ridge may be resolved into 5-pointed tubercles one of which is central, or it may be more or less strongly bowed proximally and interrupted in the middle. On the sixth segment there is a prominent pointed tubercle, or sometimes a pair of tubercles, on the dorsolateral portions of the distal dorsal border, and between these in the median line a larger pointed tubercle just within the distal edge. The segments succeeding bear a large pointed tubercle in the midline which at first is just within the distal edge but soon moves to a central position, on either side of which is a smaller tubercle situated on the dorsolateral portion of the distal edge. On the last five to nine segments before the penultimate the lateral tubercles disappear and there is only a conspicuous erect median tubercle. The opposing spine is erect, triangular, arising from nearly or quite the entire dorsal surface of the penultimate segment, and in height equal to about half the width of that segment. The terminal claw varies from not quite so long as to longer than the penultimate segment, and is moderately slender and rather strongly curved, especially in the proximal third.

The radials extend only slightly beyond the rim of the centrodorsal in the mid-radial line, but run well up in the interradial angles of the calyx; they are entirely in contact laterally. The IBr_1 are about four times as broad as long, oblong with the lateral edges and the proximal and distal borders parallel. The IBr_2 (axillaries) are triangular with the lateral angles slightly truncated, and are nearly twice as broad as long. Except in the central portion, the proximal border is more or less prominently thickened and produced directly outward, plain, scalloped, or usually armed with a few short spines or pointed tubercles. The lateral edges of the elements of the IBr series are usually plain, but they may bear one or two rather long slender pointed tubercles.

The 10 arms are 55–60 mm. long in the largest specimens. The first brachials are about four times as broad as the median length, and are from half again to twice as long exteriorly as interiorly. The proximal border is straight, but the distal border runs inward and downward at a considerable angle to the median line, then turns and runs parallel to the proximal border to the inner anterolateral angle. The inner sides are usually united in their proximal halves, but sometimes are merely in contact basally. The second brachials are considerably larger than the first and are irregularly quadrate. The first syzygial pair (composed of brachials 3+4) is about as long as broad, and is very slightly longer interiorly than exteriorly. The next three brachials are somewhat irregularly oblong, at first twice as broad as long but becoming progressively longer, and those following almost immediately become triangular, about as long as broad, with slightly produced and overlapping but smooth distal ends. After the middle of the arm the brachials become very obliquely wedge-shaped, and terminally they become elongate with somewhat convex sides.

Syzygies occur between brachials 3+4, 12+13, 17+18, and 22+23, and distally at intervals of from 2 to 6 (usually 4) muscular articulations.

P_1 is 5 mm. long with 8–10 (usually 9) segments of which the first is from two and one-half to three times as broad as the median length, noticeably broadened, with a prominent rounded or sometimes coarsely dentate carination. The second segment, which tapers rapidly distally, is from half again to twice as broad proximally as distally, and nearly or quite twice as long as the distal width. The sides converge strongly in the proximal half, then curve outward and become parallel in the distal half or third. The broad basal portion is carinate dorsally. The third segment is 2–5 (usually about 4) times as long as broad, with parallel sides or slightly broader proximally than distally. The fourth segment is more or less, and usually abruptly, shorter than the third, from 2 to 4 (usually nearer the latter) times as long as broad; rarely if the third segment is short the fourth is of the same length or somewhat longer. The segments following are similar to the fourth. The pinnule is considerably stiffened, though not spinelike, moderately stout, evenly tapering from the middle of the second segment to the tip, and shows a distinct prismatic crest, which is not raised or otherwise modified, along the middle of the dorsal side. The distal ends of the segments are perfectly smooth and unmodified.

P_2 is 5–6 mm. long with 9 or 10 segments. It resembles P_1, but is larger and stouter. The first segment and usually also the basal third of the second are carinate. P_3 is 3 mm. long with 9 segments. It is slightly less broad basally than P_1, and it tapers rapidly and evenly from the distal end of the second segment to the tip. The first two segments are carinate. P_4 is 3.2 mm. long and tapers evenly from the base to the tip. In its basal half, beyond the second segment, it is nearly twice as broad as P_3 as a result of the broadening of the second-fifth segments which are expanded to protect the gonads. The pinnule is strongly prismatic. The following pinnules are similar to P_4, slowing increasing in length and gradually losing the expansion of the earlier segments. The distal pinnules are 7.5–8 mm. long with about 20 segments most of which are from two to three times as long as broad. The distal ends of the segments are slightly prominent.

The color, freshly preserved in alcohol, is white with the arms, pinnules, and cirri with occasional narrow bands or small and usually rounded spots of bright pinkish red; or, brownish yellow, with the cirri and pinnules more or less extensively marked with white.

Notes.—The preceding description is based upon 18 specimens from *Caroline* station 78.

The type specimen from *Albatross* station 2146 was described by the author as follows:

The centrodorsal is thick discoidal with a rather large bare polar area and bears two irregular marginal rows of cirri.

The cirri are about XX, 15–17 (usually 15 or 16), 5 mm. long. The first segment is very short, the second is rather more than half as long as broad, and the remainder are about as long as broad. The second and third segments bear on the distal edge a sharp dorsal spine (as seen in lateral view) which after one or two segments moves to the middle of the dorsal side. The opposing spine is rather less than the width of the penultimate segment in length and stands out vertically from the middle of the dorsal side. The terminal claw is not quite so long as the penultimate segment and is stout and strongly curved.

The radials are visible beyond the rim of the centrodorsal, though very short. The IBr_1 are oblong, about twice as broad as long, slightly concave distally, and just in appostition laterally though not laterally flattened. The IBr_2 (axillaries) are pentagonal, about as long as broad.

The 10 arms are probably about 25 mm. long. The first brachials are wedge-shaped with the shorter inner sides united for about the proximal two-thirds. The second brachials are larger, and are irregular in shape. The brachials following are squarish, gradually becoming wedge-shaped and more obliquely wedge-shaped after the twelfth, when they are about as long as broad.

Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of 3 muscular articulations.

P_1 5 mm. long with 6 segments of which the first is short but distally produced into a rounded projection, the second is rather more than twice as long as broad, and the remainder are greatly elongated. P_2 is similar to P_1 and equally stout basally, but not quite so long. P_3 and the following pinnules are 3.5 mm. long with the first two segments short (the first somewhat broader than the second), and the third, fourth, and fifth somewhat expanded laterally to protect the gonads. The distal pinnules are lacking.

The specimen collected by Dr. Th. Mortensen between St. Thomas and St. John in 27–36 meters may be described as follows:

The centrodorsal is thin-discoidal with a broad flat polar area. The cirrus sockets are arranged in one and a partial second marginal rows; the distal row is complete and apparently quite regular, the proximal consisting of sockets interpolated between those of the first or distal row.

The cirri are short and rather stout, about 8 mm. long, composed of 18–20 segments of which the first is very short and those following slowly increase in length so that the eighth and following are about as broad as their ventral length. The first segment has its distal edge produced into a transverse ridge which has a straight or more or less convex crest. The second and following have the distal edge produced into a high transverse ridge with a straight or more or less concave plain, finely scalloped, or serrate crest which is very prominent at either end; this ridge distally gradually moves anteriorly, becoming median on the sixth or seventh, soon after moving to a position near the proximal end of the segment and appearing in lateral view as a slender, sharp, erect anterior dorsal spine equal to about one-third the lateral diameter of the segment in height. On about the fifth or sixth segment the transverse ridge becomes a broad tridentate ridge with one large median and two smaller lateral teeth. Toward the end of the cirrus the lateral teeth become smaller and finally disappear so that on the last three or four segments before the penultimate there is only the single median tooth. The opposing spine is longer than the spine on the antepenultimate segment and is erect, subterminal, and equal to the distal width of the penultimate segment in height. The terminal claw is about as long as the penultimate segment and is abruptly curved in the center, becoming slender distally.

The distal edges of the radials are even with the border of the centrodorsal in the midradial line, but extend anteriorly in the interradial areas; their distal ends are slightly separated. The IBr_1 are from three to three and one-half times as broad as long; the distal edge is straight and the proximal edge is straight or slightly and evenly convex; adjacent IBr_1 form an angle of about 60° with each other interradially. The IBr_2 (axillaries) are broadly pentagonal, about as broad as long; their sides are from one-third to one-half as long as those of the IBr_1 and make with them an angle of about 120°.

The 10 arms are 50 mm. long.

The first syzygy is between brachials 3+4, the second from between brachials 11+12 to between brachials 14+15, and the third from between brachials 15+16 to between brachials 19+20. The distal intersyzygial interval is from 2 to 6 (usually 3 or 4) muscular articulations.

P_1 is stiffened and more or less spinelike, slender, 6 mm. long, composed of 9 segments of which the first is short and triangular, twice as broad as long, the second is trapezoidal, twice as long as its proximal width, the third is nearly four times as long as broad, and those following are four or more times as long as broad, the terminal becoming shorter again. P_2 is more slender than P_1, 6 mm. long with 13 segments most of which are greatly elongated. P_3 is 4 mm. long with 9 segments. P_4

is 3.5 mm. long with 10 segments. The pinnules following slowly increase in length, the distal pinnules being 6 mm. long with 16 segments most of which are about twice as long as broad.

Localities.—*Albatross* station 2146; off Colon, Canal Zone (lat. 9°32′00″ N., long. 79°54′30″ W.); 62 meters; broken shells; April 2, 1884 [A. H. Clark, 1908, 1909, 1911, 1923] (1, U.S.N.M., 22676).

Caroline station 78; north of Puerto Rico (lat. 18°29′42″ N., long. 65°31′15″ W.); 320 meters of wire out; February 25, 1933 (18, U.S.N.M.).

Between St. Thomas and St. John, Virgin Islands; 27–36 meters; Th. Mortensen, December 23, 1905 (1, C. M.).

No locality [Hartlaub, 1912].

Geographical range.—Caribbean Sea; from the Virgin Islands and north of Puerto Rico to off Colón, Canal Zone.

Bathymetrical range.—From 62 meters downward to an undetermined depth.

History.—In the *Challenger* report on the comatulids published in 1888 Dr. P. H. Carpenter mentioned *Antedon armata* as among the 10-armed species of the *Blake* collection, and gave as the habitat Florida Straits in 35 fathoms. The habitat as given is the locality and depth at which the type specimen of *armata* was taken; but this was dredged by the *Bibb* and not by the *Blake.* After Carpenter's death Hartlaub found three specimens that had been sent him with the *Blake* collection. One was presumably, though not certainly, the type of Pourtalès's *Antedon armata* from the *Bibb* collection, one was an example of *caribbea*, and one was a small *armata.* It is probable, therefore, that Carpenter did not distinguish *caribbea* from *armata*, but included both under the latter name.

On the establishment of the genus *Oligometra* in my paper published on April 11, 1908, *Oligometra caribbea* A. H. Clark was given without comment in the list of included species. The description of this species appeared in another paper published on May 14 of the same year. The species was based upon a single broken specimen that had been dredged by the *Albatross* at station 2146. In a paper published in 1909 I compared *Oligometra caribbea* with my new species *O. studeri.* In my memoir on the crinoids of Australia published in 1911 I remarked that *Oligometra* (*Austrometra*) *thetidis* is curiously similar to *Analcidometra caribbea* from the Caribbean Sea.

In 1912 Dr. Clemens Hartlaub redescribed Pourtales's *Antedon armata* from three specimens, two large and one very small, that had been sent him with the *Blake* collection. His figures show that one of the larger specimens was an example of *A. caribbea.*

In a list of the crinoids of the Atlantic Ocean published in 1923 I included *Analcidometra armata* giving as the range from the Bahamas and Dry Tortugas to Barbados and Colon in 5.5–64 meters. The locality Colon refers to the type specimen of *A. caribbea*, which at that time was regarded as a synonym of *armata.*

Genus ICONOMETRA A. H. Clark

Antedon (part) Hartlaub, Nachr. Ges. Göttingen. May 1890, p. 172, and following authors.

Oligometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126; vol. 22, 1909, p. 7; Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28; Proc. U. S. Nat. Mus., vol. 43, 1912, pp. 384, 400; Crinoids of the Indian Ocean, 1912, pp. 37, 175.—H. L. Clark, Carnegie Inst. Washington Publ. 212, 1915, p. 105.—A. H. Clark, Journ. Washington Acad. Sci., vol 5, No. 6, 1915, p. 214; Unstalked crinoids of the *Siboga*-Exped., 1918, p. 130.—H. L. CLARK, The echinoderm fauna of Torres Strait, 1921, p. 23.—GISLÉN, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 29.

Oligometrides (part) A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 126.

Iconometra A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, May 1929, pp. 635, 643 (diagnosis; genotype *I. speciosa*, new species).—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 49.

Diagnosis.—A genus of Colobometridae in which P_1, P_2, and P_3 are similar, elongated, stiffened, evenly tapering, and composed of segments which beyond the first two are much elongated; P_2 is longer than P_1 or P_3; P_a is present; the cirri are rather stout and are composed of 15–23 short subequal segments none of which are longer than broad, bearing dorsally a more or less marked transverse ridge situated at or very near the proximal end; the arms are 10–20 or more in number; the division series, which are always 2, are broad and are in lateral contact except for water pores; and the brachials are broader than long, except in the outer portion of the arms.

Genotype.—*Iconometra speciosa* A. H. Clark, 1929.

Geographical range.—From Sagami Bay, Japan, and the Philippine Islands southward to Torres Strait and westward to Solor Strait and the coast of Annam.

Bathymetrical range.—From the shore line down to 148 meters. Three of the species (*bellona*, *anisa*, and *japonica*) are littoral, extending from the shore line down to probably not more than 50 meters, but the other two (*speciosa* and *marginata*) are known only from depths greater than 100 meters.

Remarks.—The genus *Iconometra* is very closely related to the genus *Oligometrides*, with which it agrees in having P_1, P_2, and P_3 similar, stout, stiffened, and smooth, and usually also in having the dorsal transverse ridge on the cirrus segments near the proximal end. In *Oligometrides* P_1 is longer and proportionately stouter than the pinnules following, and the cirrus segments bear dorsally a second prominent transverse ridge, or row of tubercles, or paired tubercles, near the distal end. In *Iconometra* P_2 is longer and proportionately stouter—or at least stouter—than P_1, and in those species in which the transverse ridge is proximal the second transverse ridge near the distal end of the cirrus segments so characteristic of *Oligometrides* is typically wholly absent, though in certain cases it may be indicated, or even feebly developed, on some of the outer segments, though never on the outermost ones.

While agreeing in its pinnulation closely with the other species, *I. japonica* has the dorsal transverse ridge on the cirrus segments at first near the distal end, later becoming median, in this respect approaching the species of *Oligometra*. Occasionally, also, the third-fifth segments of the genital pinnules in this species are slightly broadened, so that it approaches the species of *Austrometra* and *Analcidometra*.

Except for *I. japonica* the species of this genus as herein understood are so extraordinarily alike in the details of their pinnule and cirrus structure as strongly to suggest that they are really only forms of the same specific type. All of them are rare, and none is sufficiently well known to enable us to say anything very definite about it.

It is possible—indeed quite probable—that *speciosa* will eventually turn out to be the same as the previously described *bellona*. The differences between the two as we know them at present appear to be well within the range of individual variation.

It is possible that *marginata*, which is based upon immature individuals, will prove to be merely an immature form of *anisa*.

History.—In spite of the striking uniformity in details characteristic of the included species, the history of this genus is singularly involved. The first species known was described by Dr. Clemens Hartlaub in the genus *Antedon*. Hartlaub said that this form (*Antedon japonica*) is very similar in its habitus to *Antedon serripinna* and that it is very likely that a further knowledge of the two will lead to their eventually being united.

In my first revision of the old genus *Antedon* in 1907 I retained *japonica* in the genus *Antedon*, but upon the establishment of the new genus *Oligometra* in 1908 *japonica* was transferred to it, and here it has remained until the present time. In 1912 I described a second species (*marginata*) in the genus *Oligometra*, saying that it was most closely related to *O. adeonae*. In 1915 Dr. Hubert Lyman Clark described a third species (*anisa*) in the genus *Oligometra*, which he said was no doubt related to *O. carpenteri*. In 1918 I placed my *Oligometra marginata* and Dr. H. L. Clark's *O. anisa* in the synonymy of *Oligometrides adeonae*, leaving *japonica* in the genus *Oligometra*.

In 1920 I described a new species from the Philippine Islands under the name of *Oligometrides bellona*.

In 1929 I established the genus *Iconometra* for a new species (*speciosa*) from the coast of Annam. I said that this new genus is most closely allied to *Oligometrides* from which, however, it appears to be quite distinct. In addition to the type species, *speciosa*, I included in it Doctor Clark's *anisa* and my own *bellona*.

Up to the present time *japonica* has remained in the genus *Oligometra*, being regarded, largely on the basis of Hartlaub's statement, as a smooth pinnuled form of *O. serripinna*, and *marginata* has been left in the synonymy of *Oligometrides adeonae*.

KEY TO THE SPECIES IN THE GENUS ICONOMETRA

*a*¹. About 20 arms; P_1, P_2, and P_3 of about the same length; P_4 scarcely more than half as long as the pinnules preceding; cirri with 20–23 segments, about 13 mm. long; arms 75 mm. long (off southern Annam; 146 meters) ---------- **speciosa (p. 91)**

*a*². Arms 10 or 11 in number.

- *b*¹. More than 20 cirrus segments; P_2 and P_3 similar and of nearly or quite the same length; P_1 similar, but shorter.
  - *c*¹. Transverse ridge on the cirrus segments proximal; 11 arms about 100 mm. long (Philippine Islands; 0–16 [?73] meters) ---------- **bellona (p. 93)**
  - *c*². Transverse ridge on the cirrus segments at first subterminal, later becoming median; 10 arms 40–75 mm. long (Sagami Bay, Japan; 0–46 meters) ---------- **japonica (p. 94)**
- *b*². Fewer than 20 cirrus segments; P_3 shorter than P_2.
  - *c*¹. P_2 markedly longer, as well as stouter, than P_1; proximal pinnules with 10–16 segments; cirri XVI–XXIII, 15–19, 10–12 mm. long; 10 arms 45–65 mm. long (Torres Strait to Amboina; 0–100 [?130] meters) ---------- **anisa (p. 97)**
  - *c*². P_1 slightly longer than P_2; proximal pinnules with 8 or 9 segments.
    - *d*¹. P_2 slightly stouter than P_1; cirri XV, 15–16, 7 mm. long; 10 arms 30 mm. long (Solor Strait; 113 meters) ---------- **marginata (p. 103)**
    - *d*². P_2 exactly resembling P_1; cirri IX, 10–11, 2.5 mm. long (Andaman Islands). **intermedia (p 103)**

ICONOMETRA SPECIOSA A. H. Clark

PLATE 10, FIGURES 48, 49

Iconometra speciosa A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, pp. 635, 643 (description; off Cape Padaran), pl. 40, figs. 1, 2.—GISLÉN, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 2 (southern Annam), p. 5 (French Indo-China), p. 6 (range).
Iconometra spinosa PRESTON, Zool. Rec. for 1929, 1930, p. 28 Echin. (editorial error).

Diagnostic features.—The arms are about 20 in number, and are 75 mm. long; the cirri are XL, 20–23, 13 mm. long.

Description.—The centrodorsal is hemispherical, slightly flattened, 3.5 mm. broad at the base. The dorsal pole, which is about 1 mm. broad, is studded with small scattered tubercles. The cirrus sockets are arranged in three rows and a partial fourth row.

The cirri are about XL, 20–23, about 13 mm. long. The first segment is very short, the second is twice as broad as long, and those following gradually increase in length so that the fifth or sixth and those succeeding are very nearly as long as broad, becoming terminally quite as long as broad. The cirri of the peripheral row are all lacking; in these probably all the segments are broader than long. On the third or fourth segment the proximal end is thickened dorsally. On the segment succeeding this thickening rises into a transverse ridge with a very finely dentate crest which is convex when the segment is viewed from the end. On the segments following this crest becomes straight. Distally the crest becomes gradually shorter, but the process remains as a proximal transverse ridge as far as the antepenultimate segment. The opposing spine is prominent, higher than the transverse ridge on the preceding segment, conical or with a chisel-shaped transversely elongated edge, median or situated in the proximal portion of the penultimate segment, and inclined more or less proximally. The cirri are rather stout, and are of uniform width throughout.

The distal borders of the radials are just visible beyond the rim of the centrodorsal. They are narrowly thickened, or are provided with a continuous row of fine beadlike tubercles. The IBr_1 are short, four or five times as broad as long, somewhat higher in the median line than laterally. The lateral borders are in contact basally, but from the point of contact the sides of each IBr_1 converge strongly. The proximal borders of the IBr_1 are everted and slightly thickened, or are provided with a continuous row of small beadlike tubercles. The outer portions of the distal border, and the lateral borders, are slightly everted. The IBr_2 (axillaries) are sharply triangular, twice as broad as long. The proximal border is straight. The lateral angles are just in contact with those of their neighbors, and therefore extend beyond the truncated anterolateral angles of the IBr_1. Except in the middle of the proximal edge, the borders all around are everted. A prominent high and narrow synarthrial tubercle is present on the articulation between the elements of the IBr series. The IIBr and IIIBr series are 2, and resemble the IBr series. Only a single externally developed IIIBr series is present.

The arms are apparently 21 in number, and are about 75 mm. in length. The first brachials are wedge-shaped, twice as long exteriorly as interiorly, and between three and four times as broad as long in the median line. The outer border is produced into a narrow flange of uniform width, and the inner is in contact with that of its fellow for about the proximal half, the two sides of the adjacent first brachials then diverging at an angle that varies from broadly obtuse to acute. The second brachials are larger than the first, and the proximal and distal borders make a greater angle with each other so that these brachials are almost triangular, the inner side being extremely short or quite reduced to a point. The first syzygial pair (composed of brachials 3+4) is slightly longer interiorly than exteriorly, and is from half again to twice as broad as the median length. Toward the inner end of the distal border a sharp angle indicates the end of the fulcral ridge. The next three brachials are oblong, about three times as broad as long, with sharp angles on the distal borders indicating the ends of the fulcral ridges. After the eighth the brachials become triangular, about half again as broad as the maximum length, with the longer side slightly convex. In the outer half of the arm the brachials become very obliquely wedge-shaped, remaining broader than long, and distally elongate. In profile view the dorsal surface of the brachials in the proximal half of the arm is seen to rise gradually to the distal end, so that the distal end of one brachial is higher than the proximal end of the brachial succeeding, though there is no overlapping. The synarthrial tubercles on the IIBr and IIIBr series and between the first two brachials become progressively less and less marked.

P_1 is 11 mm. long, and is composed of 15 segments. It is slightly stiffened and tapers evenly and gradually from the base to the slender, but not flexible, tip. The first segment is slightly broader than long, or about as long as broad, the second, which is slightly trapezoidal, is from half again to nearly twice as long as the width of the distal (shorter) end, and the third is nearly three times as long as broad. The segments following are about four times as long as broad, becoming even longer in the distal portion of the pinnule. P_2 is 11.5 mm. long with 16 segments. It resembles P_1 and is scarcely stouter basally, but it tapers more gradually and therefore is slightly stouter and stiffer in the distal half. P_3 is 10.5 mm. long with 15 segments, and resembles P_2. P_4 is 6.5 mm. long with 13 segments, and tapers more rapidly than the pinnules preceding. The first segment is twice as broad as long, the second is nearly as long as broad, the third is nearly twice as long as broad, and the fifth and following are three or four times as long as broad. The fifth or sixth and following segments have the distal edge dorsally slightly everted and armed with fine short spines. P_5 is 5 mm. long with 12 segments. It is about as stout at the base as P_4, but it tapers much more rapidly and becomes more delicate distally. Its component segments are relatively shorter than those of P_4.

The color in alcohol is purple, the elements of the division series with central patches of yellow, and the brachials each with a terminal stripe of yellow on the pinnule-bearing side. In their outer halves the arms become banded, series of purple brachials with terminal yellow marks alternating with series of yellow brachials with purple proximal marks. The lower pinnules are yellow, more or less washed with purple at and toward the ends of the segments. The centrodorsal and the cirri are yellow.

Locality.—Off Cape Padaran, southern Annam (lat. 11° 38′ N., long. 109° 41′ E.); 146 meters; cable repair ship *Patrol*, Eastern and Associated Telegraph Company;

from the Cape St. James-Hong Kong cable (R. H. Ellis), June 4, 1927 [A. H. Clark, 1929] (1, B. M.).

History.—This species is only known from the single specimen collected by the *Patrol* off Cape Padaran in 80 fathoms. Through the courtesy of C. C. A. Monro, of the British Museum, this specimen was sent to me for study in 1928 and was described and figured by me in 1929.

ICONOMETRA BELLONA (A. H. Clark)

Oligometrides bellona A. H. Clark, Proc. Biol. Soc. Washington, vol. 33, 1920, pp. 21, 22 (description; southwest of Sorsogón Bay, Luzón, 9–40 fms.; Port Galera, Mindoro).

Iconometra bellona A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 643 (listed).

Diagnostic features.—The 11 arms are about 100 mm. long; the cirri are XXIV, 21–23, about 13 mm. long, with the dorsal transverse ridges on the segments proximal; P_2 and P_3 are similar and of about the same length, 16 mm. long with 14–16 segments, longer than P_1.

Description.—The centrodorsal is thin discoidal, the dorsal pole flat or slightly convex, about 2.5 mm. in diameter, and studded with well-spaced and evenly distributed granular tubercles. Within the circle of cirri dorsally there is a more or less complete circle of empty cirrus sockets, each occupied in the center by a more or less hemispherical median tubercle.

The cirri are XXIV, 21–23, about 13 mm. long. The cirrus segments are subequal, not quite so long as broad. On the third the proximal border is broadly thickened, this thickening on the fourth and following becoming a high transverse ridge with a sharp straight crest which on the segments in the outer half of the cirri becomes, when the segments are viewed endwise, evenly convex, then gradually gablelike, and on the antepenultimate reduced to a single spine situated on the proximal edge of the segment. On some of the middle and outer segments of certain cirri midway between the proximal transverse ridge and the distal edge there is a transverse row of minute tubercles representing the distal transverse ridge in *O. adeonae;* these, however, are not always present, and when present are inconspicuous.

The division series are broad and thin and in lateral contact, with their borders narrowly flattened against those of the plates on either side and therefore straight. The synarthrial tubercles are very prominent and sharp, and are slightly produced. The IIBr series are 2.

The arms are 11 in number, about 100 mm. long, resembling those of *O. adeonae.*

The pinnules are essentially similar to those of *O. adeonae.* P_1 is 13 mm. long, rather stout, stiff, tapering evenly from the base to the tip, and is composed of 15 segments all but the first of which are longer than broad, the outer being about twice as long as broad. P_2 is similar to P_1, 16 mm. long, but proportionately stouter and tapering more gradually, with 15 or 16 segments of which the first is broader than long, the second is about as long as broad, and the following are longer than broad, mostly about twice as long as broad. P_3 is similar to P_2 and of the same length or very slightly shorter, with 14 or 15 segments. P_4 is similar to P_3, 12 mm. long with 14 segments. The following pinnules are shorter and more flexible, with shorter segments. P_5 is 9 mm. long with 12 segments. The distal pinnules are slender, 13 mm. long with 22 segments.

Notes.—The specimen from Port Galera resembles the type and has also 11 arms.

Abnormality.—In the type specimen one of the distal pinnules is forked, the first segment being an axillary and bearing two similar pinnules.

Localities.—Southwest of Sorsogón Bay, Luzón, Philippine Islands (lat. 12° 50′ 00″ N., long. 123° 50′ 25″ E.); 16-73 meters; cable repair ship *Rizal* (A. S. Day), September 1912 [A. H. Clark, 1920, 1929] (1, M. C. Z., 705).

Port Galera, Mindoro (the port or largely enclosed bay formed by a promontory on the northwestern side of the extreme northern peninsula of Mindoro and outlying islands); Dr. Lawrence E. Griffin [A. H. Clark, 1920, 1929] (1, M. C. Z., 706).

History.—I described this species under the name of *Oligometrides bellona* in 1920 from two specimens in the Museum of Comparative Zoology, one from Sorsogón Bay, Luzón, in 9-40 fathoms, that had been taken from a cable raised to the surface by the cable repair ship *Rizal* in September 1912, and one that had been collected at Port Galera, Mindoro, by Dr. Lawrence E. Griffin.

In 1929 upon the establishment of the genus *Iconometra* this species was listed by me as *Iconometra bellona.*

ICONOMETRA JAPONICA (Hartlaub)

PLATE 10, FIGURES 53, 54; PLATE 11, FIGURES 55, 56; PLATE 26, FIGURES 134, 135

Antedon japonica HARTLAUB, Nachr. Ges. Göttingen, 1890, p. 172 (description; Japan); Nova Acta Acad. German., vol. 58, No. 1, 1891, p, 84 (detailed description and comparisons; Japan); pl. 5, fig. 49.—A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 353 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 478 (listed); vol. 43, 1912, p. 384 (identity); Crinoids of the Indian Ocean, 1912, p. 37 (same).

Antedon iaponica HAMANN, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).

Oligometra japonica A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (listed); vol 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (compared with *O. serripinna* from Tonga; discussion of this and comparable varieties of *O. serripinna*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (=*Antedon japonica* Hartlaub), p. 400 (Japan; redescription of the type); Crinoids of the Indian Ocean, 1912, p. 37 (identity), p. 175 (synonymy; localities [these include those of *Prometra owstoni* and *P. longipinna*]); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (compared with *O. occidentalis* and with *O. serripinna*); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 130 (in key; range).—GISLÉN, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 29 (Mortensen's station 17; notes), figs. 19–22, p. 27.

Diagnostic features.—The 10 arms are 40–75 mm. long; the cirri are XIV–XXIII, 20–29, the longest 9–15 mm. long; the dorsal transverse ridges on the segments are at first subterminal, finally becoming median; P_2 and P_3 are similar and of nearly or quite the same size, stout, stiffened, recurved, and entirely smooth, composed of 10–18 segments of which the second-fourth are slightly carinate; P_1 is similar but shorter and somewhat more slender distally; the distal ends of the proximal brachials are only slightly produced.

This is a rather robust species, stouter and usually larger than the other species of the genus.

Description.—The centrodorsal is a moderately thick disk with a slightly concave dorsal pole. The cirri are arranged in two marginal rows.

The cirri are about XIX, about 20. The segments are subequal, short, the first 6 or 7 broader than long, and those following slowly increasing in length so that the outermost are a little longer than broad. The distal segments bear a slight transverse ridge set with fine spines. The cirri are somewhat compressed laterally in their distal portion.

The radials are barely visible in the interradial angles of the calyx. The IBr_1 are laterally somewhat united, or entirely free. The IBr_2 (axillaries) are rather short and pentagonal. On the middle of their articulation with the IBr_1 there is a slight elevation. Some of the axillaries and the first two brachials have traces of a slight production of the outer border.

The 10 arms are about 40 mm. long. They have a rather rough dorsal surface. The 8 or 9 lowest brachials have fairly smooth articulations. On the middle of the articulation between the first and second brachials there is a slight elevation. The first brachial is short, approximately rhombic, and interiorly closely united with its fellow. From the tenth onward the brachials are bluntly wedge-shaped, with their distal ends somewhat produced and overlapping laterally on either side the bases of the brachials succeeding. Toward the arm tips the brachials gradually become shorter and finally more discoidal.

The first syzygy is between brachials 3+4, the second is from between brachials 9+10 to between brachials 12+13 (usually between brachials 9+10), and the distal intersyzygial interval is from 2 to 5, often 3 or 4, muscular articulations. Toward the arm tips the intersyzygial interval rises to 5 or 6 muscular articulations.

P_1 tapers rapidly after the first few basal segments, which show a tendency to carination. The pinnule is two-thirds as long, or occasionally even quite as long, as P_2 and P_3, which are less slender and taper more gradually. These pinnules, like P_1, are composed of about 12 segments which are rather flat and broad. The length of P_2 and P_3 reaches 5 mm. The three first pinnules on the inner side of the arms are somewhat smaller than the corresponding pinnules on the outer side of the arms. The length of the pinnules of the two following pairs (P_4 and P_d and P_5 and P_e) decreases, the pinnules succeeding becoming longer again and reaching a length of about 5 mm.

The disk has been lost. Sacculi are thickly set on the pinnules.

The centrodorsal and cirri are uniform light brown, and the arms are the same but with dark bands at the brachial articulations.

Notes.—The preceding description is adapted from the original description of Hartlaub. I examined Hartlaub's type specimen in the Berlin Museum in 1910. The cirri are XXI, 21–23 (usually nearer the latter), 11 mm. long. The cirrus segments are subequal, the outer slightly broader than long. On the sixth a subterminal transverse ridge appears which becomes median on the last one or two before the penultimate. This transverse ridge is very low and inconspicuous, being most conpicuous on the last two or three segments where it is very narrow and may become reduced to a small tubercle. The opposing spine is subterminal, and leans slightly anteriorly. It reaches in height about one-third the distal width of the penultimate segment.

One of the specimen from near Misaki has the cirri XXI, 22–29, 15 mm. long.

The outer cirrus segments are very slightly broader than long. The arms are about 75 mm. long.

Another specimen has the arms 65 mm. long. P_1 is 4.5 mm. long with 15 segments. P_2 is 5 or 6 mm. long with 18 perfectly smooth segments. Both of these pinnules are rather strongly prismatic. P_3 is slightly shorter than P_2, though otherwise similar to it. The following pinnules are shorter and more slender, but stiffened. The cirri are XXIII, 20–22, 12 mm. long. The outer cirrus segments are about as long as broad, or very slightly broader than long.

The other four specimens are essentially similar to the latter, but in one of them P_a is absent on all the arms.

In the specimen from Mortensen's station 17, as described by Gislén, the cirri are XIV, 21–22, from 7 to 9 mm. long. They are arranged in a single row on the centrodorsal. Most of the cirrus segments are broader than long, only in some cirri the most distal segments become as long as broad. A transverse ridge is developed from the third segment onward, later a double spine.

The 10 arms are 70 mm. long. Weak synarthrial tubercles are present. The distal intersyzygial interval is 4 or 5 muscular articulations.

P_1 is from 2.6 to 3.2 mm. long with 9–11 segments. P_2 is from 4 to 5 mm. long with 10–12 segments. P_3 is from 3.2 to 3.5 mm. long with 9 or 10 segments. Especially P_2 is stout, stiffened, and almost smooth. At the distal ends of the distal pinnule segments there is, however, sometimes very insignificant ornamentation. The longest segments are from one-half to three-quarters again as long as broad. P_a is absent in 7 cases.

The disk is from 2.5 to 4 mm. in diameter, strongly incised, and without granules.

The cirri are uniformly bright brown. The arms are banded with white and purple. The distal pinnules have purple spots.

Gislén said that although the cirri are arranged in a single crowded row only, and the arms are nearly twice as long as in the type specimen, this specimen most probably belongs to *Oligometra japonica*. The cirrus segments are unusually short, thus approaching those in the genus *Decametra*, but they agree rather well with the original description.

Gislén remarked that this specimen resembles rather closely a specimen in the Upsala Museum that he had referred to *Decametra mylitta* (see page 188), but in the latter the cirrus segments are still shorter, in the longest distal segments the length being rarely more than two-thirds or three-fourths of the width.

Localities.—Near Misaki, Sagami Bay, Japan; 10–15 meters; Prof. Franz Doflein, October 11, 1904 (6, U.S.N.M., 35772; Munich Mus. [original No. 293]).

Mortensen's station 17; Misaki, Sagami Bay, Japan; off the Biological Station; 46 meters; sand; June 9, 1914 [Gislén, 1927].

Japan; Dr. Franz Martin Hilgendorf [Hartlaub, 1890, 1891; A. H. Clark, 1907, 1908, 1912, 1915, 1918] (1, Berl. M.).

Geographical range.—Southern Japan; definitely known only from Sagami Bay.

Bathymetrical range.—From shallow water down to 46 meters.

History.—This species was first described by Dr. Clemens Hartlaub in 1890 as *Antedon japonica* from a specimen from Japan that had been collected by Dr. Franz Martin Hilgendorf. It was described by him in greater detail and figured in 1891.

Hartlaub said that *Antedon japonica* in its general appearance much resembles *A. serripinna*, and it is possible that a further knowledge of the two forms will later lead to their union. But *japonica* lacks the feature that induced Carpenter to bestow the name *serripinna* upon the other, that is, the overlapping of the individual segments of the proximal pinnules, which gives these pinnules a serrate profile. Also, P_2 is approximately as large as P_3 whereas in *serripinna* it is noticeable for its larger size. The cirri of *japonica* are arranged in two rows on the centrodorsal.

In my first revision of the old genus *Antedon* published in 1907, *japonica* was retained in that genus as therein restricted, but it was transferred to the genus *Oligometra* upon its establishment in 1908. In 1908 I recorded and gave notes on a specimen identified as *Oligometra japonica* that had been collected by Mr. Alan Owston in Sagami Bay. This specimen was later described as the type of a new species, *Prometra owstoni*. In a revision of the family Himerometridae published early in 1909 *japonica* was listed as a species of the genus *Oligometra*. In 1910 I examined the type specimen of Hartlaub's *Antedon japonica* in the Berlin Museum, and in 1912 I published notes upon it. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Oligometra japonica* and gave the synonymy and the localities from which it is known. The locality Philippine Islands and the depth 58 fathoms refer to *Alisometra longipinna*, misidentified as *Oligometra japonica*, and the depth 55 fathoms refers to the type specimen of *Alisometra owstoni*, which was originally misidentified as *O. japonica*. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I included *japonica* in the key to the species of *Oligometra*, giving as the habitat southern Japan.

In 1927 Dr. Torsten Gislén recorded and gave notes on a specimen that had been dredged by Dr. Theodor Mortensen in Sagami Bay, Japan, in 1914.

ICONOMETRA ANISA (H. L. Clark)

Plate 9, Figures 45, 46; Plate 11, Figure 57; Plate 12, Figures 58–61

Oligometra anisa H. L. Clark, Carnegie Inst. Washington Publ. 212, 1915, p. 105 (description; Maër).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 126 (in synonymy of *Oligometrides adeonae*).—H. L. Clark, The echinoderm fauna of Torres Strait, 1921, p. 23 (notes and comments), pl. 1. fig. 10 (colored), pl. 4, figs. 1, 3 (colored), pl. 21, figs. 1–3, pl. 36, figs. 1*a–e*.

Oligometrides adeonae (part) A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 126.

Iconometra anisa A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 643 (listed).—H. L. Clark, Great Barrier Reef Exped., 1928–29, Scientific Reports, vol. 4, No. 7, 1932, p. 202 (*Magneta* station xix); Echinoderm fauna of Australia, 1946, p. 49 (notes).

Diagnostic features.—The cirri have 15–19 segments and are 10–12 mm. long; the transverse ridges are proximal becoming median distally, or sometimes proximal with a small distal one; P_2 is longer and somewhat stouter than P_3; the 10 arms are 45–65 mm. long.

Description.—The centrodorsal is thin-discoidal with about 15 well-separated small conical papillae on the flat dorsal pole. The cirrus sockets are arranged in one and a partial second crowded marginal rows.

The cirri are XVI, 18–19, about 10 mm. long. In the most developed cirri the segments beyond the first two are subequal, all about as long as broad, and in lateral view the cirri are of uniform width throughout. On the third or fourth segment the proximal border becomes slightly raised, forming a low transverse ridge visible in lateral view as a slight tooth near the proximal end of the segment. At about the middle of the cirrus, when the proximal transverse ridge has become considerably shortened, the central portion of the distal end on the dorsal side becomes prominent, projecting dorsally as a shorter transverse ridge broadest in the middle so that the crest is triangular when viewed dorsally. When viewed laterally the last 8 or 10 segments before the penultimate are seen to be provided dorsally with two low but prominent and practically equal teeth, one near either end. In dorsal view the proximal process, though progressively narrowing toward the tip of the cirrus, is seen to be broader than the distal. The opposing spine is median or submedian, very slender, sharp, and erect, much longer than the processes on the preceding segments, its height being equal to one-fourth or one-third the width of the segment. The terminal claw is somewhat longer than the penultimate segment, rather slender, and more strongly curved proximally than distally.

In less-developed cirri the lateral width increases gradually from about the end of the proximal third, reaching a maximum in the distal third. The distal ends of the segments are rather strongly sinuate. The segments, especially the longer ones, are slightly constricted centrally.

A typical cirrus may be described as follows. The first segment is very short, 3 or 4 times as broad as long, the second is about half again as broad as long, and the fourth or fifth is about as long as broad. The next 5 to 8 segments are somewhat longer than broad, those succeeding becoming shorter again, the last 9 or 10 being usually about as long as broad, or slightly broader than long. The cirri become rather strongly compressed in the outer half, which is strongly recurved.

The distal portion of the radials is visible beyond the rim of the centrodorsal, forming a band 7 or 8 times as broad as the median length. The distal edge of the radials is straight, and their lateral edges are separated by a very narrow V. The IBr_1 are almost oblong, between 3 and 4 times as broad as long. The lateral borders are very slightly divergent—almost parallel—and the proximal and distal borders are straight. The IBr_2 (axillaries) are almost triangular, somewhat broader than long, with the truncated lateral angles forming short lateral borders about one-third as long as the lateral borders of the IBr_1, with which they make a broadly obtuse angle. The anterior edges are straight, and the anterior angle is only slightly less than a right angle. The lateral edges of the elements of the division series and first two brachials are somewhat swollen.

The 10 arms are about 45 mm. in length. The first brachials are wedge-shaped, twice as long exteriorly as interiorly, and about two and one-half times as broad as the exterior length. The inner ends of adjacent first brachials are in contact interiorly in their proximal third, the outer two-thirds diverging at an obtuse angle. The second brachials are somewhat larger and more obliquely wedge-shaped than the first. The first syzygial pair (composed of brachials 3+4) is half again as long interiorly as exteriorly, trapezoidal, with the distal edge at right angles to the longitudinal axis of the arm and the proximal edge strongly oblique. The next 4 brachials are oblong, rather more than twice as broad as long. The brachials succeeding become very obliquely wedge-shaped, almost triangular, with the longer side somewhat convex, and later less obliquely wedge-shaped and as broad as long. The distal portion of the arms is missing.

Syzygies occur between brachials 3+4, 9+10 (or 10+11), 14+15, and distally at intervals of from 3 to 6 (usually 5) muscular articulations.

P_1 is 6 mm. long with 9+ segments, stout, and tapering evenly to the tip. The first segment is about twice as broad as the median length, with the proximal border roundedly angulate. The second segment is about one-third again as long as broad. The third segment is twice as long as the median width, slightly narrower distally than proximally, and very slightly constricted centrally. The following segments are mostly about three times as long as broad, becoming somewhat longer toward the end of the pinnule. The first, second, and third segments are distinctly, though bluntly, carinate on the side toward the arm tip, this carination dying away on the fourth. The segments in the outer portion of the pinnule have the distal edge on the side toward the arm tip slightly everted and coarsely dentate. P_2 is stouter basally than P_1 and tapers more gradually. It is of the same character as P_1, differing only in its superior size and greater length, being apparently about 3 mm. longer. The first two segments are rather sharply carinate, and the third and following have the distal edge abruptly everted and serrate. P_3 is smaller, shorter, and somewhat less stout than P_2, and is composed of 12 segments. It is of the same width basally as P_1 and appears to be of about the same length or slightly longer. Its component segments are slightly shorter than those of P_1, and it is somewhat less rigid. P_4 is scarcely more than half as long as P_3 and is composed of 10 segments. It is about half as broad as P_3 at the base and tapers rapidly to the tip. The segments are proportionately shorter than are those of P_3, becoming about as long as broad on the fourth and about twice as long as broad terminally. P_5 and the following pinnules are somewhat shorter than P_4, and are more slender and flexible.

Notes.—The preceding description was drawn up from one of the specimens from *Magneta* station XIX, which was very kindly lent me for study by Dr. Hubert Lyman Clark.

Dr. Clark's original description, based upon specimens from Maër, is as follows: The centrodorsal is moderately large, but notably thick, about 5 mm. in diameter, with the bare dorsal area about 2 mm. across and minutely tuberculated.

The cirri are XXI–XXIII, 15–17, relatively long (9 or 10 mm.) and stout. The transverse ridges on the distal segments are minute or wanting, but the opposing claw is marked. None of the segments are obviously longer than broad.

The elements of the IBr series and the first two brachials have well-marked ventrolateral processes.

There are 10 arms which are composed of 80 brachials. The first half-dozen brachials are more or less quadrate, and those succeeding are wedge-shaped with flaring and slightly overlapping distal ends, becoming quadrate and longer than broad at the arm tip.

Syzygies occur between brachials 3+4, 9+10, and distally at intervals of 6–8 muscular articulations.

All the pinnules are more or less cylindrical. P_1 is about 7 or 8 mm. long, of 10 or 11 segments, and moderately stiff. P_a is similar, but often distinctly larger. P_2 and P_b are about equal, distinctly the largest and most spikelike of the pinnules, of

13–15 segments, with rough and spiny distal ends. P_3 is much shorter than P_2, but rather stout, with 10 or 11 segments. P_c is smaller, with only 8 segments. P_4 is the smallest pinnule, much shorter than P_3. P_d is nearly equal to P_c. The succeeding pinnules are gradually longer until at the middle of the arm they are 6 mm. long and have about 20 segments.

The color in life is very variable, ranging from clear lemon yellow or canary yellow with hardly a purple mark through variegated purple and yellow, or variegated brown and white, to finely variegated shades of gray and white. Elsewhere Dr. Clark mentioned rather deep maroon and white, and orange-brown and white.

Of the 7 specimens from the south reef at Mer taken on October 24, 1913 (M. C. Z., 595) the largest has the arms 70 mm. long.

The cotype taken at Mer in October 1913 (M. C. Z., 552) is a very slender specimen with the cirri and proximal pinnules much more slender than usual, and the dorsal processes on the cirri only faintly indicated.

The two specimens from *Magneta* station XIX are small and dark colored.

The specimen from Amboina Bay may be described as follows: The centrodorsal is discoidal, rather thin, with the flat dorsal pole studded with small tubercles that decrease in size toward the center. The cirrus sockets are arranged in two irregular alternating rows.

The cirri are XX, 17–19, about 10–12 mm. long, stout and strongly recurved. The segments are subequal, all broader than long; those beyond the second bear a high and prominent transverse ridge which at first is situated in the proximal half but becomes central distally. There is no production of the distal dorsal edges of the segments. The opposing spine is short, stout, conical, and erect.

One IIBr 2 series is present. The division series, which have straight edges, are just in contact laterally through narrow flangelike productions of their sides.

The 11 arms are about 65 mm. long.

P_1 is 8 mm. long, evenly tapering from the base to the tip and much stiffened, composed of 12–14 segments of which the first is from half again to twice as broad as long, the second is nearly as long as broad with the sides converging slightly distally, the third is half again as long as broad, the fourth is twice as long as broad or even longer, and those following are longer, increasing in length to the seventh, which is about four times as long as broad, and then decreasing slightly. The last segment is short, conical, and sharply pointed. The outermost five or six segments have the distal edge slightly everted and spinous. P_2 is 11 mm. long, stouter than P_1 and tapering more gradually but otherwise similar to it, with 15 or 16 segments of which the ninth–eleventh, which are the longest, are about three times as long as broad, and the ninth or tenth and following have the distal edge narrowly everted and finely spinous; the terminal segment is a short sharp conical point. P_3 is about 10 mm. long with 14 or 15 segments and resembles P_2. P_4 is 6 mm. long with 12 segments and resembles P_1, but the outer segments have slightly more prominent distal ends and the terminal portion is more flexible. P_a is everywhere present and resembles P_1.

Localities.—Mer, Murray Islands, Torres Strait; southwest reef; H. L. Clark, 1913 [H. L. Clark, 1915, 1921; A. H. Clark, 1918, 1929] (1, M.C.Z., 594 [holotype]).

Mer, Murray Islands, Torres Strait; south reef; H. L. Clark, October 14, 1913 [H. L. Clark, 1915, 1921; A. H. Clark, 1918, 1929] (1, M.C.Z., 597). Same locality, October 24, 1913 [H. L. Clark, 1915, 1921; A. H. Clark, 1918, 1929] (7, M.C.Z., 595).

Mer, Murray Islands, Torres Strait; H. L. Clark, October 1913 [H. L. Clark, 1915, 1921; A. H. Clark, 1918, 1929] (3, M.C.Z., 552 [cotype], 596, 598).

Magneta station XIX; about one-half mile north of Eagle Island, Great Barrier reef; 18 meters; shell gravel; rich *Halimeda;* March 10, 1929 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Amboina Bay; about 100–130 meters; stones; February 25, 1922 (1, C.M.).

Geographical range.—From Torres Strait to Amboina.

Bathymetrical range.—From the shore line down to 100 (?130) meters.

Occurrence.—Dr. Hubert Lyman Clark said that, except for the species of Comasteridae, this was the commonest crinoid at Mer, Murray Islands; but it was not really common, since he found only 12 individuals in five weeks of diligent search. It was not infrequently met with near the outer margin of the southwestern reef flat, but unfortunately it was not common enough to permit of any extended observations on its habits and reactions. It was not ordinarily at all active, but clung very tenaciously to the fragment of rock or coral to which its cirri attached it. The cirri are notably strong, and it was frequently no easy task to detach them.

History.—This species was first described under the name *Oligometra anisa* by Dr. Hubert Lyman Clark in 1915. He remarked that although it is no doubt related to *O. carpenteri* this species is readily distinguished by the more numerous cirri with fewer segments, by the shorter arms with about half as many brachials, and the utterly different lower pinnules.

In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I included *Oligometra anisa* in the synonymy of *Oligometrides adeonae* without comment.

In 1921 Dr. H. L. Clark wrote that the great diversity in color shown by this species led him to suppose that he had found several species of 10-armed colobometrids at Mer, but critical study in Cambridge brought him to the conclusion that all the individuals represent a single species. He remarked that in spite of his somewhat detailed description of the pinnules I put *anisa* in the synonymy of *Oligometrides adeonae*, whereas it is evidently an *Oligometra*, and even after an examination of the holotype and all the other specimens he had insisted that they represent *adeonae*. He said that I had lent him specimens of *adeonae* from the Aru Islands [*Siboga* station 273] which he had compared carefully with the Murray Island material. There was no doubt in his mind that the two species are quite distinct; the cirrus segments have conspicuous transverse ridges in *adeonae* which are wanting (or at most very faint) in *anisa*, while the difference in the lower pinnules is even more marked. In *adeonae* P_1 is the largest, P_2 is slightly smaller, P_3 is still smaller, and P_4 is still smaller, but similar. In *anisa* P_1 is smaller than P_2, which is much larger and with more segments than in *adeonae;* P_3 is about as large as P_1 or a little smaller; P_4 is abruptly smaller than P_3 and quite different in form. In *adeonae* the lower pinnules tend to be prismatic, while in *anisa* they are more terete. In some of the specimens of *anisa* certain of the lower pinnules have been broken off and are regenerating, a condition which is quite deceptive at first sight. There is also some diversity in the size and proportions of the lower pinnules which is probably due in large part to differences in age. Dr. Clark remarked that the characteristic features of this species are, however, quite constant. It seems to be most nearly related to *Oligometra japonica* (Hartlaub), but differences in the cirri, the number and arrangement of the syzygies, and in the lower pinnules made him think it probably distinct, and until specimens can be compared it is better to keep the two forms separate. He said a fine orange-brown and white individual was notable for its very conspicuous lower pinnules and the stout cirri. But he said that in spite of individual diversities the species is really not very variable in its essential specific characters.

Upon the establishment of the new genus *Iconometra* by me in 1929, *Iconometra anisa* was given as one of the three constituent species.

ICONOMETRA MARGINATA (A. H. Clark)

Plate 10, Figures 50–52

Oligometra marginata A. H. Clark, Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 267 (*nomen nudum;* a species related to *O. adeonae* and *O. thetidis* known from Solor Strait), p. 269 (cirri compared with those of *O.* [*Decametra*] *intermedia*); Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 40 (description; *Siboga* station 305); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 126 (=*Oligometrides adeonae* [error]).—Gislén, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 33 (discussion).—A. H. Clark, Temminckia, vol. 1, 1936, p. 308 (identity).

Oligometrides adeonae (part) A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 126 (station 305; description), p. 276 (listed), pl. 20, fig. 49.

Iconometra marginata A. H. Clark, Temminckia, vol. 1, 1936, p. 295 (listed), p. 308 (*Snellius* station 60*; notes).

Diagnostic features.—A small and delicate form with 10 arms 30 mm. long; P_1 is slightly longer than P_2, though slightly less stout; the proximal pinnules have 8 or 9 segments; the cirri are XV, 15–16, 7 mm. long.

The three specimens referred to this species are all small and immature. They may prove to be the young of *I. anisa.*

Description.—The dorsal pole of the centrodorsal is papillose.

The cirri are XV, 15–16, 7 mm. long, and are moderately stout. The first segment is short, those following gradually increasing in length so that the fourth, fifth, or sixth and following are about as long as broad. The third and following segments have a strong transverse ridge near the proximal dorsal margin. This ridge is prominent and high, with a finely serrate crest. It lies about one-third of the distance between the proximal and distal margins of the segments. In the proximal half or three-quarters of the cirri the distal dorsal edge of the segments is more or less everted, so that there is the same bidentate appearance that is characteristic of the cirri of *O. adeonae.* On the earlier segments this eversion of the distal edge may be nearly as high as the transverse ridge, but it soon decreases in height and disappears entirely in the distal half or quarter of the cirri. The smaller cirri are quite without it.

The 10 arms are 30 mm. long. The proximal arm structure resembles that of *O. adeonae.* The ossicles of the IBr series and the first two brachials are broad and are in lateral contact through produced and flangelike ventrolateral borders the outer edges of which are parallel to the longitudinal axes of the segments that bear them.

P_1 is 5 mm. long with 9 segments, rather slender but considerably stiffened, recalling P_2 in the more delicate varieties of *Stephanometra protectus.* The first segment is about one-third again as broad as long, the second is half again as long as the proximal width and is slightly trapezoidal, the third is about three times as long as its proximal diameter, the fourth-sixth are slightly longer, and those following rapidly diminish in length to the small terminal segment. The second-fourth segments are slightly constricted centrally. P_2 is 4 mm. long with 9 segments, similar to P_1 but very slightly stouter and with slightly shorter segments. P_3 is from 2.5 to 3.0 mm. long with 8 segments, and is more slender and less stiffened than the pinnules preceding. P_4 is 2 mm. long, small, slender, and weak, with 8 or 9 segments. The next two pinnules are similar to P_4, and those succeeding gradually become elongated, the distal pinnules being from 4.5 to 5.0 mm. in length with 13 segments of which the majority are from 2 to 3 times as long as broad and very slender.

The color in alcohol is white.

Notes.—The specimens from *Willebrord Snellius* station 60* are small and immature. One is light violet with the ends of the segments narrowly yellow, and the other is white with groups of narrow transverse lines of deep violet, one to a segment.

Localities.—*Siboga* station 305; mid-channel in Solor Strait, off Kampong Menanga; 113 meters; stony bottom; February 8, 1900 [A. H. Clark, 1912, 1918; Gislén, 1919] (1, Amsterdam Mus.).

Willebrord Snellius station 60*; lat. 6° 58′ 00″ N., long. 121° 52′ 30″ E.; 72–80 meters; September 5, 1929 [A. H. Clark, 1936] (2, L. M.).

History.—This species was originally described in 1912 under the name *Oligometra marginata* from a single specimen collected by the *Siboga* at station 305; but in the detailed report upon the *Siboga* collection published in 1918 *Oligometra marginata* was placed in the synonymy of *Oligometrides adeonae*, of which it was supposed to be a young individual. The discovery of two additional specimens by the *Willebrord Snellius* again brought up the question of the status of this form, and further study showed, in the light of information acquired subsequent to the publication of the *Siboga* report, that whatever its relations may be with the other species of the recently recognized genus *Iconometra*, *marginata* has nothing to do with *Oligometrides adeonae*.

ICONOMETRA INTERMEDIA (A. H. Clark)

Oligometra intermedia A. H. CLARK, Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 269 (description; Andaman Islands); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 125, footnote (=*Prometra intermedia*).—GISLÉN, Kungl. Svenska Vet. Handl., vol. 59, No. 4, 1919, p. 33 (discussion).

Prometra intermedia A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 125 (in key; range).

Diagnostic features.—The cirri are 2.5 mm. long with 10 or 11 segments of which the sixth and following are about as long as broad and the distal bear paired transversely elongate dorsal spines; P_1 is the longest and stiffest pinnule on the arm, 2.5 mm. long with 8 segments; P_2 is 2 mm. long with 8 segments and resembles P_1; P_3 is only half as long as P_2, though it also has 8 segments; the arms are about 18 mm. long.

Description.—The centrodorsal is small, discoidal, with the dorsal pole 0.8 mm. in diameter, flat and papillose.

The cirri are IX, 10–11, 2.5 mm. long, very short, very stout, and strongly curved. The earlier segments are broader than long, but the sixth and following are about as long as broad. The second segment has the distal dorsal edge produced and finely spinous, this production becoming on the fourth a median transverse ridge with prominent lateral angles which project slightly beyond the lateral profile of the segment and encroach slightly on the lateral surface. On the distal segments this transverse ridge becomes narrower and partially resolves itself into paired transversely elongate spines, at the same time moving to a position proximal to median. Here there may be an eversion of the median part of the distal dorsal edge of the segments so that in lateral view the segments may present more or less of the bidentate appearance characteristic of *Oligometrides adeonae.*

The 10 arms are about 18 mm. long. The division series and the arms in general resemble those of *Oligometra serripinna,* but the elements of the IBr series and the first brachials have broad and prominent ventrolateral processes as in the species of *Stephanometra.*

P_a is absent. P_1 is 2.5 mm. long with 8 segments and is the longest and stiffest pinnule on the arm, though it is not especially stout. The first segment is half again as broad as long, the second is about as long as broad, the third is twice as long as broad, the fourth and fifth are between two and one-half and three times as long as broad, and those following rapidly decrease in size. The third and following bear long and prominent spines at the prismatic angles which after the fourth are very conspicuous. P_2 is 2 mm. long with 8 segments and exactly resembles P_1. P_3 is small and slender, about 1 mm. long with about 8 segments. The pinnules following are weak and delicate, not tapering so rapidly as P_3.

Locality.—Investigator; Andaman Islands [A. H. Clark, 1912, 1918; Gislén, 1919] (1, I. M.).

Remarks.—The specimen upon which this species was based is obviously young, and the absence of P_a as well as the relatively large size of P_1 are very likely due simply to immaturity. The form evidently belongs here, as is indicated by the characters of the cirri, the broadening of the elements of the IBr series, and the similarity of the first two pinnules, and not in *Oligometra* in which it was originally described, or in *Decametra* (*Prometra*) in which it was subsequently placed.

History.—This species was described by me in 1912 under the name *Oligometra intermedia* from a specimen collected by the Royal Indian Marine Surveying steamer *Investigator* in the Andaman Islands. In my memoir on the crinoids of the *Siboga* expedition published in 1918 I transferred it to the genus *Prometra* and included it in the key to the species of that genus.

In 1919 Dr. Torsten Gislén wrote that in such little species as *intermedia* one may suspect that the absence of P_a is due to youth and is not a mature character, as it is, for instance, in *Decametra.* He left undecided the question whether *intermedia* is to be considered as a real species or as a mere juvenile form of some larger species, possibly *Oligometrides adeonae.*

UNIDENTIFIABLE SPECIES

[ANTEDON FIELDI Bell]

Antedon fieldi Bell, Proc. Zool. Soc. London, 1894, p. 396 (listed), p. 401 (description; Macclesfield Bank, 22–30 fathoms).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 471 (unrecognizable; certainly does not belong in the *Spinifera* group); Crinoids of the Indian Ocean, 1912, p. 38 (of Bell, 1894=?), p. 286 (original description quoted; remarks); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 70 (original reference cited; Macclesfield Bank, 22–30 and 13 fathoms; appears to be a small species belonging to some genus of Mariametridae or Colobometridae; strong transverse ridges on the cirrus segments).

Remarks.—Bell's description reads: "Allied to *A*[*ntedon*]. *moorei,* but distinguished from it by the broad spine [*i. e.,* transverse ridge] on the cirrus joints. Cirri about 20, with 18 joints, almost completely covering the centrodorsal. No syzygy on radials [IBr series] or distichals [IIBr series]; the first on the third brachial. Colour bright purple with lighter cirri. Macclesfield Bank, 22–30 fathoms." Bell assigned this species to Carpenter's *Spinifera* group. It was named for Commander A. M. Field, R. N., commanding officer of H. M. S. *Egeria.*

I examined this specimen at the British Museum in 1910. There are strong transverse ridges on the cirrus segments. It is probably a species of *Iconometra*, possibly *I. speciosa.*

Genus PETASOMETRA A. H. Clark

Antedon (part) HARTLAUB, Nachr. Ges. Göttingen, May 1890, p. 174, and following authors.

Cyllometra (part) A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357.

Petasometra A. H. CLARK, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 25 (diagnosis; genotype *Antedon clarae* Hartlaub, 1890; assigned to the family Colobometridae; comparisons); Die Fauna Südwest-Australians, vol. 4, Lief. 6, 1913, p. 311 (detailed description and comparisons; genotype; Shark Bay to Amboina); Journ. Washington Acad. Sci., vol. 5, No. 1, 1915, p. 8 (very highly developed in the Australian fauna); Unstalked crinoids of the *Siboga* Exped., 1918, pp. 111, 112 (in key), p. 113 (key to the included species).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 22, 23, 27; Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, pp. 2, 17.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 51 (key to the included species).

Diagnosis.—A genus of Colobometridae including medium-sized species with 10–22 arms 85–120 mm. long, with the IIBr and IIIBr series (when present) 4(3+4), rarely 2; P_1 and P_2 are similar, somewhat enlarged and evenly tapering, with 22–24 segments, longer and stronger than P_3; P_a is absent; there are 19–31 cirrus segments, all much broader than long.

This genus is distinguished from *Cyllometra* by having P_1 and P_2 similar, by having the IIBr and IIIBr series usually 4(3+4), and by the larger size.

Geographical range.—From Flores to Amboina and Darwin, Australia, and southward to Shark Bay, Western Australia.

Bathymetrical range.—From the short line down to 40 meters.

History.—The genus *Petasometra* was established by me in 1912 with the genotype *Antedon clarae* Hartlaub, 1912, a species which since 1907 had been assigned to the genus *Cyllometra.* At the same time a second species, *P. helianthoides*, was described.

KEY TO THE SPECIES IN THE GENUS PETASOMETRA

a^1. More than 20 arms; 28–31 cirrus segments (Shark Bay, Western Australia, to Darwin, Northern Territory; 0–9 meters) ---------- **helianthoides** (p. 105)

a^2. Arms 10–14 in number; 20–29 (usually 20–25) cirrus segments (Amboina and Flores; 0–40 meters) ---------- **clarae** (p. 109)

PETASOMETRA HELIANTHOIDES A. H. Clark

Petasometra helianthoides A. H. CLARK, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 26 (description and comparisons; South Passage, Shark Bay, 9 m.); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 311 (description; same locality), pl. 4, fig. 4 (dorsal view), fig. 5 (ventral view); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (already recorded from Shark Bay); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 224 and following (detailed account of the distribution in Australia).—H. L. CLARK, Biol. Results Fishing Exper. F. I. S. *Endeavor*, 1909–14, vol. 4, pt. 1, 1916, p. 6 (characteristic of the west Australian subregion).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 113 (in key; range).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 22, 27.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 51.

Petasometra brevicirra H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 36 (description; False Cape Bossut), figs. 1, 2, p. 37; Echinoderm fauna of Australia, 1946, p. 51.

Petasometra variegata H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 38 (near Shell Islands, Darwin, 3–6 fathoms; description), figs. 3, 4, p. 39; Echinoderm fauna of Australia, 1946, p. 51.

Diagnostic features.—There are 19–31 arms 80–85 mm. long. The cirri are XIX–XXIII, 22–31, from 20 to 22 mm. long.

Description.—The centrodorsal is thin-discoidal, with a broad flat dorsal pole 4 mm. in diameter. The cirrus sockets are arranged in a single regular closely crowded marginal row.

The cirri are XIX, 28–31, from 20 mm. to 22 mm. in length. The cirrus segments are subequal, about twice as broad as long, the basal shorter, the last 5 or 6 becoming somewhat longer. The second segment has the distal dorsal edge produced and bluntly serrate. On those following this serrate ridge in dorsal view becomes more and more deeply crescentic, and on the fourteenth and following it becomes a median straight, finely and rather bluntly serrate, transverse ridge which in lateral view appears as a minute spine. The opposing spine is large, with the apex subterminal, arising from the entire dorsal surface of the penultimate segment and equaling about one-half the width of that segment in height. Owing to the closely crowded condition of the cirrus sockets the first 3 segments of the cirri are sharply flattened laterally as in related species.

The radials are concealed by the centrodorsal in the midradial line, but are visible as low triangles in the interradial angles of the calyx. The IBr_1 are very short, about 6 times as broad as long, with the proximal and distal edges parallel to each other and the lateral borders parallel to the middorsal line and not in contact with those of their neighbors. The IBr_2 (axillaries) are very broadly pentagonal, from 2 to 3 times as broad as long, with the lateral borders, which are about two-thirds as long as those of the IBr_1, diverging slightly. The anterolateral angles of the IBr_1 and the adjacent proximal angles of the axillaries are rounded off. There are in the type specimen 10 IIBr series of 4 (3+4), and 2 IIIBr series of 4 (3+4) both of which are developed on the same IIBr series. The division series are strongly rounded dorsally, and resemble those of *Heterometra savignii;* their component elements do not have extended ventrolateral borders.

The 22 arms of the type specimen are 85 mm. in length. The first 2 brachials are subequal, slightly wedge-shaped, about 4 times as broad as the median length. The first are interiorly united for the proximal two-thirds, beyond the point of union diverging at a right angle. The first syzygial pair (composed of brachials 3+4) is oblong, two and one-half times as broad as long. The next 4 brachials are short, approximately oblong, about 4 times as broad as long, those following becoming obliquely wedge-shaped, two and one-half times as broad as long, and less obliquely wedge-shaped distally.

P_a is always absent. P_D is from 11 mm. to 12 mm. in length and is composed of 27–29 segments of which the first 4 or 5 are broader than long and the remainder are about as long as broad, becoming slightly longer than broad terminally. The pinnule is moderate in size, smooth, evenly tapering, and very delicate distally. P_1 is 10 mm. long with 22 segments, resembling P_D but very slightly more slender. P_2 is 10 mm. long with 25 segments, resembling P_1. P_3 is 6 mm. long with 19 segments, smaller and weaker than the pinnules preceding. The following pinnules are similar to P_3. The distal pinnules are 11 mm. long, slender, with 29 segments which are short, scarcely half again as long as broad.

The color in alcohol is light yellowish, with the dorsal pole of the centrodorsal, except for a central spot, and the articulations dark brown.

Notes.—The preceding description is based upon the type specimen. A specimen from near the Shell Islands, Darwin, was described by Dr. Hubert Lyman Clark as a new species under the name *Petasometra variegata.* According to him the centrodorsal is thin discoidal with the broad and slightly concave dorsal pole over 3 mm. in diameter. The cirrus sockets are arranged in a single closely crowded marginal row.

The cirri are about XXIII, 22–25, 11 mm. long, with the distal portion markedly recurved. The cirrus segments are very short and broad proximally but become narrower and even compressed distally, with little change in length. The basal segments are twice as broad as long, but the distal are not much broader than long. The dorsal transverse ridge is present from the second segment onward, but it is never very conspicuous and even the opposing spine may be rather small, though it is usually well marked.

The radials are concealed. The IBr_1 are well developed but short, about four times as broad as long. The IBr_2 (axillaries) are also short, the greatest length being scarcely one-third the width, the distal angle rounded, and the anterior sides slightly concave. There are seven IIBr 4 (3+4) series, and three IIBr 2 series. Of the IIIBr series, nine are 4 (3+4), one is 2, and one is 5 (4+5). The division series are all rather rugged and stout, more or less in contact, and the IIBr series are a little inclined to be swollen.

The 31 arms are relatively short and stout; all are more or less damaged, but they were apparently not over 80 mm. long (perhaps 100 mm. in life). The brachials are broad and short, about twice as broad as long, beyond the seventh or eighth becoming wedge-shaped.

Syzygies occur between brachials 3+4 and 11+12, and distally at intervals of from 6 to 8 brachials (7 to 9 muscular articulations).

P_D is not more than 10 mm. long, rather stout, with 20–23 segments; the basal segment is large, oblong, broader than long; the second is more nearly square and considerably smaller; the third and following are successively smaller and become cylindrical; their margins are all smooth; the distal portion of the pinnule tapers rapidly to a terete but by no means slender tip. P_1 is very similar and scarcely longer. P_2 is similar but a trifle smaller and with fewer segments. P_3 is distinctly smaller and P_4 much smaller and with only about a dozen segments. The pinnules succeeding are small, but soon increase in length and number of segments until distally there are again more than 20 in each pinnule, but they are all small. P_a is absent.

The color in alcohol is very dark brown, almost black, variegated with cream color. Many arms are almost white dorsally, at least in the distal half, but not the pinnules. Many cirri are white dorsally and ventrally, but blackish on the sides.

In a second specimen taken at the same place and time the cirri are XX, 22–24, short, thick, and strongly recurved. The 19 arms are 70–80 mm. long. Of the nine IIBr series eight are 4 (3+4) and one is 2. The first syzygy is between brachials

3+4, but the next is far out on the arm beyond the thirtieth brachial, and there are very few all together.

This specimen (dry) is dull gray-brown variegated and spotted with a light yellow-brown; there is much less of the light color than there is in the other specimen.

In his field notes Dr. Clark wrote that these specimens "seemed almost black with dorsal side of arms cream white. Very handsome. Died on way home and never relaxed, hence are poor specimens." He said that in several points this handsome species (*variegata*) suggests *Antedon clarae* Hartlaub "and I have tried to convince myself that it should be called by that name, but the type of that East Indian form was much larger than the Darwin specimens, yet had only 12 arms. It also had much longer cirri and the colors and color pattern were totally different. It seems best, therefore, to keep the Australian species separate." He did not compare his new species with the Australian *helianthoides.*

Under the name *Petasometra brevicirra* he described a specimen from False Cape Bossut. In this the centrodorsal is thin discoidal with a broad flat dorsal pole about 3 mm. in diameter. The cirrus sockets are arranged in a single closely crowded marginal row.

The cirri are XXI, 18–22, about 9 mm. long, and somewhat recurved. The cirrus segments are subequal in length, but when viewed dorsally the fourth and fifth are much the broadest, the third and sixth somewhat narrower, the second and first about equal, or the first narrower. Beyond the sixth the segments decrease slightly but steadily in width until the terminal segments are no broader than long. The dorsal transverse ridge, characteristic of the genus, is present near the middle of each segment, but is not well marked until after the fifth and never becomes spiniform until the penultimate segment on which the opposing spine is fairly well developed.

The radials are concealed. The IBr_1 are well developed, about two and one-half times as broad as long. The IBr_2 (axillaries) are large, broadly pentagonal, the width not twice the height. Of the five IIBr series, four are 4 (3+4) and one is 2. The division series are all well rounded, and, except for the proximal half of the first elements, distinctly separated from each other.

The 15 arms are 45–60 mm. long. The first brachials are noticeably rounded, somewhat higher externally than internally where they are in contact for half their length or more. The second brachials are very similar and the two together are somewhat higher than the third and fourth, which are united by syzygy. The third-seventh brachials are as high an one side as on the other, but from the eighth onward they are more wedge-shaped, though they never become nearly triangular.

The first syzygy is between brachials 3+4, the second occurs after an interval of about 13 brachials (14 muscular articulations), and the following after about 8 (9).

P_D is about 8 mm. long, rather stout, with about 20 segments. The basal segments are about as broad as long and relatively large, but those following diminish rapidly in size; the distal portion of the pinnule is terete and slender, though by no means flagellate or even delicate. P_1 is very similar, a trifle longer perhaps, with about 23 segments. P_2 is similar, but a little smaller. P_3 is distinctly smaller with about 15 segments, but the transition from P_2 to P_3 is neither abrupt nor striking. Subsequent pinnules are not essentially different, but ultimately become longer and more slender; as they increase in length the number of segments rises again to exceed 20. The margins of the pinnule segments are uniformly smooth. P_a is absent.

The color (dry) is light purplish brown, the articulations between the brachials conspicuously darker. Distally the dorsal surface of some arms is evidently purple. The centrodorsal is dark purplish brown. The cirri dorsally at the base are deep buff, but pass into purplish brown ventrally and distally. There is a broad band of dark purple on each side of each cirrus near the dorsal side which becomes narrow distally and fades away at the penultimate segment. The disk is light colored except for the anal cone, which is very dark.

Dr. Clark said that the peculiarities of this unique specimen were not noted at the time of capture, and no special field notes are connected with it. It is apparently a *Petasometra*, but the short cirri with few segments and the short, rather rugged pinnules set it apart from the species previously known, while its whole appearance is strikingly different from that of the following species (*variegata*). He said that it seems strange that in all the collecting of June 1932 no further examples of *Petasometra* were taken.

This appears to be a young and immature example of *P. helianthoides*.

Remarks.—The differences between *Petasometra helianthoides* and the previously described *P. clarae* are trivial, and it is quite possible that they will eventually prove to represent the same species.

Localities.—Hamburg Southwest Australian Expedition; station 23; South Passage, Shark Bay, Western Australia; 9 meters; Drs. W. Michaelsen and Robert Hartmeyer, June 16, 1905 [A. H. Clark, 1912, 1913, 1914, 1915, 1918; H. L. Clark, 1916] (1, H. M.).

False Cape Bossut, Western Australia; H. L. Clark, September 9, 1929 [H. L. Clark, 1938].

Near Shell Islands, Darwin, Northern Territory of Australia; 5–11 meters; sponge and alcyonarian bottom; H. L. Clark, July 15, 1929 [H. L. Clark, 1938].

Geographical range.—Western and northwestern Australia from Shark Bay to Darwin.

Bathymetrical range.—From the shore line down to 9 (?11) meters.

History.—This species was originally described in my paper on the crinoids of the Natural History Museum at Hamburg, published in 1912. It was redescribed and figured in my supplementary report on the crinoids of the Hamburg Southwest Australian Expedition published in 1913.

In 1938 Dr. Hubert Lyman Clark described as *Petasometra brevicirra* a specimen that he had collected at False Cape Bossut (M. C. Z., 916) which is undoubtedly a young individual of this species, and as *P. variegata* two other specimens (M. C. Z., 917, holotype) from near Shell Islands, Darwin, also collected by himself.

PETASOMETRA CLARAE (Hartlaub)

Plate 13, Figures 62–64

[See also vol. 1, pt. 2, fig. 198 (lateral view), p. 127.]

Antedon clarae Hartlaub, Nachr. Ges. Göttingen, May 1890, p. 174 (description; Amboina); Nova Acta Acad. German. vol. 58, No. 1, 1891, p. 11 (collected by Brock at Amboina), p. 36 (in key), p. 41 (detailed description and comparisons; Amboina), p. 113 (in Göttingen Mus.), pl. 2, fig. 19.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 131 (considered as a synonym of

A. [*Cyllometra*] *manca*).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 37 (=*Cyllometra clarae*).

Antedon manca (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 131 (considered as including *disciformis* and *clarae*).

Cyllometra manca (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 350 (variability), p. 357 (listed).

Cyllometra clarae A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed); Crinoids of the Indian Ocean, 1912, p. 37 (identity), p. 158 (synonymy; Amboina).

Petasometra clarae A. H. Clark, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 27 (compared with *P. helianthoides*); Die Fauna Sudwest-Australiens, vol. 4, Lief. 6, 1913, p. 313 (same); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 113 (in key; range; references; notes; stations 50, 231), pp. 271, 274 (listed).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 22, 23.

Diagnostic features.—There are 10–14 arms which are from 85 to 120 mm. long. The cirri are VII–XXI, 19–29, from 12 to 17 mm. long.

Description.—The centrodorsal is a moderately large and thick disk with a circular and slightly concave dorsal pole. The cirrus sockets are arranged in a single marginal row.

The cirri are XXI, about 25, about 17 mm. long. The component segments are fairly equal. The proximal half of the cirri has a rather broad dorsal surface, but in the distal half the cirri become more compressed laterally. From the second or third onward the segments have a dorsal transverse ridge which at first lies almost at the distal end but in the later segments becomes more median. In the distal more compressed half of the cirri the transverse ridge passes over into a single small spine. The opposing spine is stout.

The radials are slightly visible. The IBr$_1$ are entirely free laterally. The IBr$_2$ (axillaries) are pentagonal and rather short. In the type specimen two of the postradial series bear each a IIBr series; one of these IIBr series is 2 and the other is 4 (3+4). The free outer borders of the division series are smooth, without lateral processes. Slight synarthrial tubercles are developed.

The 12 arms are about 100 mm. long. They have a smooth dorsal surface and are composed of short brachials. The first brachials are almost rhombic, and are only partially united interiorly. The second brachials are slightly shorter than the first. The first syzygial pair (composed of brachials 3+4) is slightly broader than long. The following five or six brachials are discoidal, and those succeeding are wedge-shaped, toward the ends of the arms becoming blunter and finally more squarish.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 14+15, and distally at intervals of from 5 to 9 muscular articulations.

P$_a$ is absent. P$_1$ is approximately as long as P$_2$ and P$_b$, which are rather slender, 7 mm. long, and are composed of 15–20 cylindrical segments which, with the exception of the basal, are as long as broad. The pinnules following are markedly shorter; from P$_5$ on the length of the pinnules increases, reaching 12 mm. distally.

The disk, which is only slightly incised, reaches as far as the first syzygial pair. Sacculi are numerous.

The disk is a beautiful red-brown with small and large white spots; the cirri and the central region dorsally are light yellowish brown; on the arms dark red-brown areas alternate with others of light reddish brown.

Notes.—The preceding description is adapted from Hartlaub's description of the type specimen.

One of the specimens from *Siboga* station 231 (Amboina) has 10 arms 120 mm. long. The centrodorsal is discoidal with the dorsal pole large, circular, and slightly concave, 2.6 mm. in diameter. The cirrus sockets are arranged in a single perfectly regular marginal row.

The cirri are XIV, 26–29, 17 mm. long, rather stout. Owing to the very crowded condition of the cirrus sockets, which are all in one regular row, the first segment of the cirri, as viewed dorsally, is very narrow. From this segment onward the cirri increase in width to the fourth, which is at least three times as broad as the first, and then taper almost imperceptibly to the tip. All the cirrus segments are of approximately equal length, short, about twice as broad as long. The lateral margins of the segments in the proximal half of the cirri are strongly bent, but those of the segments in the distal half of the cirri are straight. Beginning on the second or third segment there is a straight serrate transverse ridge, which is at first terminal, but becomes median on about the fifth or sixth. On the antepenultimate segment this transverse ridge is replaced by a single small median spine. The opposing spine is long, median, erect, and very much longer than the minute spine on the preceding segment, being in height equal to about half the width of the penultimate segment. The terminal claw is about half again as long as the preceding segment, stout in the basal third but becoming slender in the distal two-thirds, and strongly curved basally but becoming nearly straight distally. The dorsal surface of the cirri is broad and flat, and is rather abruptly separated from the lateral surface.

The radials are almost entirely concealed by the centrodorsal. The IBr_1 are very short, three and one-half times as broad as long, and are widely separated from their neighbors laterally. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long. The synarthrial tubercles are moderately developed. The dorsal surface of the arms is almost smooth.

P_a is absent. P_1 is 9 mm. long with 24 segments of which the first is twice as broad as long and those following gradually increase in length, becoming about as long as broad on the fourth and thereafter slightly longer than broad. P_2 is similar, but slightly longer and slightly stouter. P_3 is similar, but is somewhat smaller and shorter than P_1, 7 mm. long with 16 segments. P_4 is 4.5 mm. long with 15 segments of which the distal are elongate. The pinnules following are similar. The distal pinnules are very slender and are 12 mm. long.

The color in alcohol is yellow-brown with purplish blotches on the arms. The outer half of the cirri is purplish.

Another specimen from *Siboga* station 231 has 14 arms 120 mm. long. All four IIBr series are 4(3+4). The cirri are XVI, 23–24 (usually 23), 15 mm. long. The dorsal pole of the centrodorsal is slightly concave, 3 mm. in diameter. P_1 is 8 mm. long. P_2 is 9.5 mm. long with 22 segments. P_3 is 6.5 mm. long. P_4 and the pinnules following are 4.5 mm. long and are very delicate. The large proximal pinnules are somewhat stiffened. The distal pinnules are 9 mm. long. The color is the same as in the specimen just described.

The third specimen from *Siboga* station 231 is small with 10 arms 55 mm. long.

Of the three specimens from *Siboga* station 50 one has 11 arms 85 mm. long. One IIBrI series is present, the IIBr axillary being supported equally by the IBr axillary and by the outer side of the IBr_1. Another has 10 arms 85 mm. long, and the cirri 13 mm. long with 20–22 segments. The dorsal pole of the centrodorsal is circular, slightly concave, 2 mm. in diameter. The cirrus sockets are arranged in a single regular crowded row. The color is dark brown, with the cirri and centrodorsal light yellow-brown and the IBr series and first brachials white; there are one or two distinct white patches on individual arms. The third specimen has 10 arms 85 mm. long. The cirri are VII, 19–20, 12 mm. long. The dorsal pole of the centrodorsal is slightly concave, circular, 2 mm. in diameter. The cirrus sockets are arranged in a single perfectly regular crowded row.

These three specimens from *Siboga* station 50 differ from the large individual from station 231 in having slightly fewer cirrus segments, and in having P_3 proportionately smaller; but both these differences are directly correlated with the smaller size.

Localities.—Amboina; Dr. J. Brock [Hartlaub, 1890, 1891; A. H. Clark, 1907, 1909, 1912, 1913, 1918].

Siboga station 231; Amboina; anchorage; 40 meters; coral sand; November 14–18, 1899 [A. H. Clark] (3, U. S. N. M., E. 419; Amsterdam Mus.).

Siboga station 50; Bay of Badjo, western coast of Flores; 40 meters; mud, sand and shells; April 16–18, 1899 [A. H. Clark, 1918] (3 Amsterdam Mus.).

Geographical range.—From Amboina to Flores.

Bathymetrical range.—From shallow water down to 40 meters.

History.—This species was described by Dr. Clemens Hartlaub in 1890 from a specimen from Amboina that had been collected in 1884–85 by Dr. J. Brock. It was redescribed and figured by him in 1891.

In a paper published in 1907 I included *Antedon clarae* in the synonymy of Carpenter's *Antedon manca*, but in a revision of the family Himerometridae (as then understood) published in 1909 I listed it as a separate species under the name *Cyllometra clarae*. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Cyllometra clarae* and gave the synonymy and habitat. In a paper on the crinoids of the Hamburg Museum published in 1912 I established the new genus *Petasometra*, based upon a new species, *P. helianthoides*. To this new genus I referred *Antedon clarae*, comparing it with the new species. The comparison between *Petasometra helianthoides* and *P. clarae* was repeated in my memoir on the crinoids collected by the Hamburg Southwest Australian Expedition published in 1913. In my memoir on the crinoids of the *Siboga* expedition published in 1918 I recorded *Petasometra clarae* from stations 50 and 231 and gave notes on the specimens.

ALISOMETRA, new genus

Oligometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 308; Proc. Biol. Soc. Washington, vol. 22, 1909, p. 42; Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544; Crinoids of the Indian Ocean, 1912, p. 175.

Colobometra (*Prometra*) (part) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 322.

Prometra (part) A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214; Proc. Biol.

Soc. Washington, vol. 29, 1916, pp. 106, 108; vol. 31, 1918, p. 37; Unstalked crinoids of the *Siboga*-Exped., 1918, p. 125.

Diagnosis.—A genus of Colobometridae including small species with 10 arms 30–60 mm. long; P_1, P_2, and P_3 are similar and of the same length, stiff and spinelike, composed of 11–16 segments which have everted and spinous distal ends; the 14–21 cirrus segments are mostly about as long as broad.

Geographical range.—From southern Japan to the Philippine Islands.

Bathymetrical range.—From 100 to 106 meters.

History.—The first known species of this genus was mistaken by me for Hartlaub's *Antedon japonica* and was recorded as *Oligometra japonica* in 1908. The second species was recorded as *Oligometra japonica* in 1911. In 1912 the first species was named *Colobometra* (*Prometra*) *owstoni*, and in 1915 it was mentioned as *Prometra owstoni.* The second species was described as *Prometra longipinna* in 1916. Since 1916 both species have remained in the genus *Prometra.*

KEY TO THE SPECIES IN THE GENUS ALISOMETRA

a^1. Cirrus segments 16–21 (usually 18 or 19); P_1–P_3 with 14–16 segments; arms 55–60 mm. long (southern Japan; 100 meters) -- **owstoni** (p. 113)

a^2. Cirrus segments 14–15; P_1–P_3 with 11 or 12 segments; arms about 30 mm. long (Philippine Islands; 106 meters) -- **longipinna** (p. 115)

ALISOMETRA OWSTONI (A. H. Clark)

PLATE 13, FIGURES 65, 66

[See also vol. 1, pt. 1, fig. 351 (cirrus), p. 291; pt. 2, fig. 299 (proximal pinnules), p. 221; fig. 327 (middle pinnules), p. 227; fig. 348 (distal pinnules), p. 229.]

Oligometra japonica A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 308 (Sagami Bay, 55 fms.; notes); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 42 (compared with *O. studeri*); Crinoids of the Indian Ocean, 1912, p. 175 (in part; same record).

Colobometra (*Prometra*) *owstoni* A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 322 (new name for *Oligometra japonica* A. H. Clark, 1908, not of Hartlaub, 1890; compared with *C.* [*P.*] *brevicirra;* characters; discussion).

Prometra owstoni A. H. CLARK, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (*nomen nudum;* southern Japanese species; range and its significance); Proc. Biol. Soc. Washington, vol. 29, 1916, p. 106 (description; Sagami Bay, 55 fms.); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 125 (in key; range).

Diagnostic features.—The cirri have 16–21 (usually 18 or 19) segments and are 10 mm. long; P_1, P_2, and P_3 have 14–16 segments and are 8 mm. long; the arms are 55–60 mm. long.

Description.—The centrodorsal is discoidal, rather thick, with the broad flat polar area 2 mm. in diameter and covered with numerous small uniform rounded tubercles. The cirri are arranged in 2 irregular alternating marginal rows.

The cirri are XXVII, 16–21 (usually 18–19), 10 mm. long. The first segment is short, much broader than long, and those following gradually increase in length to the fourth or seventh (usually fifth or sixth) which, with the remainder, is about as long as broad. On the second or third segment the median portion of the distal dorsal edge becomes produced, this production on the 2 or 3 following involving the entire distal dorsal edge so that, viewed dorsally, it appears as a crescentic ridge with a serrate apex, the horns of the crescent touching the distal dorsal angles of the segments.

Gradually this crescent becomes straightened out so that beyond about the middle of the cirrus each segment bears a straight median serrate transverse ridge. Viewed from the ends of the segments these transverse ridges usually show a more or less convex profile, though on some of the cirri they may be nearly straight. Distally they become gradually narrower, on the antepenultimate segment being commonly represented by a slight median tubercle. The opposing spine is terminal or subterminal, erect, in height equal to about half the distal width of the penultimate segment, though sometimes longer; its base occupies nearly or quite all the dorsal surface of the penultimate segment. The terminal claw is about as long as the penultimate segment, stout in its proximal third but slender in the distal two-thirds, which portion usually is rather abruptly bent downward.

The distal border of the radials is even with the rim of the centrodorsal. The IBr_1 are short, about 4 times as broad as the median length, which is about one-third less than the lateral length. The lateral edges are straight, and in apposition. The IBr_2 (axillaries) are rhombic, broader than long.

The 10 arms are probably between 55 mm. and 60 mm. in length. The first brachials are short, trapezoidal, twice as long exteriorly as interiorly, with the interior edges united for about the proximal two-thirds. The second brachials are larger and irregularly quadrate. The first syzygial pair (composed of brachials 3+4) is slightly longer interiorly than exteriorly, nearly or quite twice as broad as the lesser (exterior) length. The next 2 brachials are slightly wedge-shaped, 3 or 4 times as long as the median width, and those following becomes more and more pronouncedly wedge-shaped and after the fourteenth triangular, about as long as broad, and distally wedge-shaped again and slightly longer than broad.

Syzygies occur between brachials 3+4, 13+14 (sometimes between brachials 9+10 or 10+11), and distally at intervals of 4–7 (usually 5) muscular articulations.

P_1 is 8 mm. long with 14 segments of which the first is half again as broad as long, the second is slightly trapezoidal, half again as long as the distal width, the third is twice as long as broad, and the remainder are from 3 to 4 times as long as broad. The seventh and following segments have very prominently everted and spinous overlapping distal ends. P_2 is 8 mm. long with 16 segments, similar to P_1 but with the segments proportionately slightly shorter. The sixth and following have very prominently everted and spinous distal edges. P_3 is 8 mm. long with 14 segments, similar to P_2. P_4 is 5 mm. long with 14 segments, similar to P_3 but with the segments, especially the distal, proportionately shorter. P_5 is 6 mm. long with 16 segments of which the distal become greatly elongated, and the third and following have prominently everted and spinous distal edges. The following pinnules resemble P_5, but gradually increase in length so that the distal pinnules are 8 mm. long, composed of 17 segments, most of which are about twice as long as broad, with produced and spinous distal edges. The 2 terminal segments of the distal pinnules are rather abruptly smaller and more slender than those preceding.

The color in alcohol is purple, the cirri yellow, each cirrus segment with a median ventral purple saddle; regenerated arms are yellow.

Locality.—Golden Hind; Sagami Bay, Japan (lat. 35°02′ N., long. 138°50′ E.); 100 meters; Alan Owston [A. H. Clark, 1908, 1909, 1912, 1915, 1916, 1918] (1, U. S. N. M., 35631 [Owston Coll. No. 7036]).

History.—The type and only known specimen of this species was originally recorded by me under the name *Oligometra japonica* in a paper published in 1908 on the collection of comatulids made by Alan Owston in his yacht the *Golden Hind.*

In 1909 I compared the new species *Oligometra* (*Decametra*) *studeri* to various other forms, among which was *Oligometra japonica.* At that time my conception of *O. japonica* was based upon the specimen just mentioned. In my memoir on the crinoids of the Indian Ocean published in 1912, in discussing the new species *Colobometra* (*Prometra*) *brevicirra* I said, "The only other species [besides *C.* (*P.*) *chadwicki*] with which this needs comparison is *C.* (*P.*) *owstoni* of Japan (*Oligometra japonica* A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, p. 308; not *Antedon japonica* Hartlaub, 1890), which also has short cirri resembling those of *Oligometra serripinna.*" This is the first mention of the specific name *owstoni.* In 1915 I listed *Prometra owstoni* as a southern Japanese species, and in 1916 described *Prometra owstoni* as a new species without any reference to a previous mention of the name or of the type specimen. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *owstoni* in the key to the species of the genus *Prometra,* and compared it with *Prometra longipinna,* new species.

ALISOMETRA LONGIPINNA (A. H. Clark)

Oligometra japonica A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544 (*Albatross* station 5356); Crinoids of the Indian Ocean, 1912, p. 175 (Philippine record).

Prometra longipinna A. H. Clark, Proc. Biol. Soc. Washington, vol 29, 1916, p. 108 (Philippine Islands, 58 fms.; *nomen nudum*); vol. 31, 1918, p. 37 (description; *Albatross* station 5356); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 125 (in key; range; description; *Albatross* station 5356).

Diagnostic features.—The cirri have 14 or 15 segments and are about 4 mm. long; P_1, P_2, and P_3 have 11 or 12 segments and are 5 mm. long; the arms are about 30 mm. long.

Description.—The cirri have 14 or 15 segments of which the fourth and following are about as long as broad. The length of the cirri is about 4 mm.

The arms are about 30 mm. long and resemble those of *P. owstoni.*

P_1 is 5 mm. long, stiff and spine-like, composed of 11 or 12 segments of which the first is broader than long, the second is one-third again as long as broad, and the fourth and following are from two and one-half to three times as long as broad. The terminal 3 or 4 have prominently spinous distal ends. P_2 is 5 mm. long with 11–12 segments and exactly resembles P_1. P_3 is 5 mm. long with 11 segments of which the distal are slightly more elongate than those of the preceding pinnules, and the fourth and following have everted and spinous distal ends. P_4 and the following pinnules are 3.5 mm. long with 10 segments, smaller and weaker than the pinnules preceding, though the component segments are of about the same proportions; the fourth and following segments have everted and spinous distal ends. The distal pinnules are 4.5 mm. long with 14 segments of which the third and following have slightly produced and finely spinous distal ends.

Locality.—*Albatross* station 5356; North Balabac Strait; Balabac light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″ E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911, 1912, 1916, 1918] (1, U. S. N. M., 35366).

History.—The two known specimens of this species were recorded by me under the name *Oligometra japonica* in my report on the third consignment of crinoids received from the *Albatross* Philippine expedition which was published in 1911. They had been dredged at *Albatross* station 5356. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Oligometra japonica* and gave as the range southern Japan and the Philippine Islands in 55–58 fathoms. The locality Philippine Islands and the depth 58 fathoms refer to the present species; the depth 55 fathoms refers to the type specimen of *Prometra owstoni.* The type specimen of Hartlaub's *Antedon japonica* was without a depth record. In a detailed description of *Prometra owstoni* published in 1916 I said that "*Prometra owstoni* is most nearly related to *P. longipinna* A. H. Clark from the Philippine Islands in 58 fathoms," the latter name here occurring for the first time. In my report on the unstalked crinoids of the *Siboga* expedition published in March 1918, *Prometra longipinna* was formally described from a single specimen from *Albatross* station 5356 and was included in the key to the species of *Prometra.* On May 16, 1918, *Prometra longipinna* was again formally described as a new species, the description being based upon the same specimen as the preceding one in the *Siboga* report.

Genus COLOBOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, Notes Leyden Mus., vol. 3, 1881, p. 178, and following authors.

Cyllometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357.

Colobometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 5 (diagnosis; genotype *Antedon perspinosa* P. H. Carpenter, 1881); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 362 (deficient pinnulation like *Comatilia*); Vid. Medd. Naturh. Foren. København, 1909, p. 174 (included in the family Colobometridae); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (*Antedon serripinna* of Chadwick is a new species of this genus [*Prometra*]), p. 14 (occurs in the Red Sea but no farther south [refers to *Prometra*]); Mem. Australian Mus., vol. 4, 1911, pp. 730, 731 (in keys), p. 735 (1 species in Australia), p. 773 (original reference; characters; range); Proc. Biol. Soc. Washington, vol. 25, 1912, pp. 25, 27 (lower pinnules compared with those of *Eudiocrinus pinnatus*); Crinoids of the Indian Ocean, 1912, p. 10 (absent from Japan; reason), p. 11 (represented in the Ceylon region; western limit of the large species is Ceylon), p. 12 (represented in the Red Sea region [*Prometra*]), p. 22 (distribution in detail), p. 57 (in key), p. 164 (original reference; type).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 371 (discussion).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 112 (in key), p. 123 (key to the included species).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.—A. H. Clark, Temminckia, vol. 1, 1936, p. 305.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 52.

Diagnosis.—A genus of Colobometridae including medium-sized to large species with 10 arms 40–170 mm. long; the long and rather slender cirri have 29–65 segments of which the proximal have their distal ends fringed with spines and the distal, which are shorter than the proximal, are much broader than long and bear dorsally prominent paired, or rarely single, dorsal spines; one or more pairs of proximal pinnules are elongated, much stiffened, and composed of elongated segments with very spiny distal ends; P_a is usually absent; the segments of all the pinnules, and the brachials, have spiny distal ends.

Geographical range.—From Fiji, the Philippine Islands, and Singapore southward to the Solomon Islands, Lord Howe Island, and Port Denison, Queensland, and westward to the Red Sea.

Bathymetrical range.—From the shore line down to 106 meters.

History.—The first known species of this genus was described under the name of *Antedon perspinosa* by Dr. P. H. Carpenter in 1881. In my first revision of the old genus *Antedon* published in 1907 *perspinosa* was referred to the new genus *Cyllometra*, and in 1909 it was made the type of the new genus *Colobometra*, which included also *C. suavis*. In 1912 *Colobometra chadwicki*, which had been described by me in 1911, was referred to a new subgenus *Prometra*, together with *Colobometra* (*Prometra*) *owstoni* and a new species *C.* (*P.*) *brevicirra*. In 1918 *Prometra* was definitely separated from *Colobometra*, and is herein considered as a synonym of *Decametra*. The two species *owstoni* and *longipinna*, heretofore referred to *Prometra*, are herein assigned to the new genus *Alisometra*.

KEY TO THE SPECIES IN THE GENUS COLOBOMETRA

a^1. Cirri very long with about 60 (53–65) segments of which the longest are about one-third again as long as broad; P$_3$ slightly larger than P$_2$; following pinnules to P$_6$ or P$_8$ similar, decreasing slightly in length; arms 120–150 mm. long (Fiji, Lord Howe Island and Port Denison, Queensland, north to northern New Guinea [Jobi] and westward to the Paternoster Islands; 0–31 [?36] meters) -- **perspinosa** (p. 117.)

a^2. Cirri shorter, with not more than 53 segments; P$_3$ only exceptionally longer than P$_2$.

- *b*^{1}. Cirri with 35–53 (usually 45–50) segments of which the longest are usually not so long as broad, rarely slightly longer than broad; P$_3$ similar to P$_2$ and of the same length, rarely slightly longer; arms 110–170 mm. long (Philippine Islands to Singapore and southward to Amboina; littoral) -- **vepretum** (p. 124.)
- *b*^{2}. Only exceptionally more than 40 cirrus segments, of which the longest are longer than broad.
  - *c*^{1}. P$_2$ markedly longer and stouter than the pinnules following, very stiff and spinelike; P$_3$ similar to P$_2$ but shorter and more slender; 29–40 (usually 30–35, very exceptionally more than 40) cirrus segments; arms 40–105 (usually 45–80) mm. long (Philippine Islands south to the Moluccas and the Lesser Sunda Islands, and westward to Ceylon; 42 [?27] –106 meters) -- **discolor** (p. 128.)
  - *c*^{2}. P$_2$ to P$_6$ or P$_7$ approximately equal in length and stoutness.
    - *d*^{1}. P$_1$ much less stiff than P$_2$, with none of the component segments more than very slightly longer than broad; P$_2$ to P$_7$ approximately equal in length and similar, with only a very slight development of spines on the distal borders of the component segments.
      - *e*^{1}. The 18–22 cirrus segments before the penultimate bear single median dorsal spines; P$_1$ has 21 segments (Philippine Islands; 36–42 meters) ------------ **suavis** (p. 132.)
      - *e*^{2}. The 3 or 4 cirrusse gments before the penultimate bear singlem edian dorsals pines, P$_1$ has 14 or 15 segments (Red Sea; 55 meters) ------------------ **arabica** (p. 132.).
    - *d*^{2}. P$_1$ resembles P$_2$ and is stiff and spinelike, composed of 10 segments of which the fourth and following are about four times as long as broad; only the antepenultimate cirrus segment bears a single median dorsal spine; P$_2$ to P$_6$ similar and of approximately equal length (Solomon Islands) ------------------------------ **diadema** (p. 133.)

COLOBOMETRA PERSPINOSA (P. H. Carpenter)

PLATE 14, FIGURES 67–69

Antedon perspinosa P. H. CARPENTER, Notes Leyden Mus., vol. 3, 1881, p. 178 (description; Jobie).—BELL, Proc. Zool. Soc. London, 1882, p. 533 (listed), p. 534 (specific formula).—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 746 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 54, 193, 366, 378.—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 85 (*Antedon lovéni* Bell, 1884, a synonym; type lacks P$_a$ [specimen from Amboina described and figured is *C. vepretum*]).—HAMANN, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 562 (P$_a$ absent, though this not noticed by Carpenter); Notes Leyden Mus., vol. 33, 1911, p. 176 (notes on the type); Mem. Australian Mus., vol. 4, 1911, p. 713 (history); p. 719 (found by Hartlaub to include *Antedon insignis* Bell, 1882, and *A. lovéni* Bell, 1884);

Crinoids of the Indian Ocean, 1912, pp. 34, 37 (identity).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 381 (listed; Tobie- [=Jobie-] Inseln).

Antedon insignis Bell, Proc. Zool. Soc. London, 1882, p. 534 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 746 (specific formula).—von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, p. 18 (myzostomes), p. 40 (Port Denison, 3–4 fms.; *Alert*; myzostomes); vol. 20, pt. 61, 1887, p. 3 (name altered by Bell in the *Alert* report to *A. lovéni*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 56 (of Bell, 1882=*A. lovéni* Bell, 1884).—Braun, Centralbl. Bakteriol. und Parasitenk., vol. 3, 1888, p. 185 (myzostomes).—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, p. 713 (change of name by Bell), p. 719 (identity discovered by Hartlaub).

Antedon lovéni Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula), p. 158 (description; Port Denison), pl. 10, figs. C [not A as given in the text], *a–e* [on the plate itself there are 2 figures lettered B and none lettered C; the B in the middle of the upper margin should be C].—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 54 (listed), p. 56 (of Bell, 1884=*A. insignis* Bell, 1882), p. 194 (in key), pp. 205, 206 (P_a absent; comparison with *A.* [*D.*] *informis*), pp. 366, 378 (range).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 86 (synonym of *perspinosa*).—Walther, Einleitung in die Geologie als historische Wiss., 1894, p. 298 (after Carpenter).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, p. 714 (of Bell, 1884=*perspinosa*), p. 716 (credited to Australia by Carpenter); Crinoids of the Indian Ocean, 1912, pp. 31, 34 (identity).

Cyllometra belli A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357 (listed; new name for *Antedon lovéni* Bell, 1884, not *A. lovéni* Bell, 1882); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 516 (name not necessary).

Cyllometra perspinosa A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357 (listed); vol. 52, pt. 2, 1908, p. 220 (compared with *C. suavis*).

Colobometra perspinosa A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed); Vid. Medd. Naturh. Foren. København, 1909, p. 177 (compared with *C. vepretum*); Notes Leyden Mus., vol. 33, 1911, p. 176 (=*Antedon perspinosa;* type in the Leyden Mus.), p. 188 (Jobi; detailed description of the type; Amboina [error; refers to *C. vepretum*]); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 440 (East Indian species occurring south to Port Jackson), p. 433 (range on the east Australian coast); Mem. Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia), p. 722 (occurs south to Port Jackson and Sydney), p. 773 (synonymy; characters; Port Jackson; Lord Howe Island; notes; range); Crinoids of the Indian Ocean, 1912, pp. 31, 34, 37 (identity), p. 164 (synonymy; description of the type; comparisons; localities [record from Amboina refers to *C. vepretum*]); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 37 (published references to specimens in the B. M.; Port Denison, 3–4 fms.; *Alert*); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 223 and following (detailed account of the distribution in Australia); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 123 (in key; range), p. 124 (synonymy; notes; stations 40, 149, 240), pp. 271, 273, 274 (listed), pl. 28, fig. 103.—H. L. Clark, The echinoderm fauna of Torres Strait, 1921, p. 192 and following (range in Australia).—A. H. Clark, Temminckia, vol. 1, 1936, p. 308 (Binongko, 6–10 meters; Ternate, 2–4 meters; notes).—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18. No. 10, 1940, p. 3 (Fiji), p. 14 (locality; notes); pl. 3, fig. 14.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52 (Australian records; notes).

Diagnostic features.—The cirri are long, tapering distally, composed of 53–65 (usually about 60) segments of which the longest are slightly longer than broad; P_3 is slightly longer and larger than P_2; the following pinnules to P_6 or P_8 are similar to P_3, slightly decreasing in length; the arms are 120–150 mm. long. This is a large species with long cirri that become slender distally, and a very strong development of spines on the segments of the pinnules and of the cirri, and on the distal ends of the brachials.

Description.—The type specimen of *Antedon perspinosa* from the island of Jobie was thus described by Carpenter:

The centrodorsal is discoidal.

The cirri are about XX, about 60, long and slender. The lowest segments are slightly longer than broad. Each segment in the lower and middle parts of the cirri expands toward its distal end so as to overlap the base of the next segment, and its edges are fringed with small spines. This overlap gradually disappears on the ventral side of the later segments, and becomes gradually replaced on the dorsal side by two small spines near the middle of each segment. In the terminal segments these spines become smaller and closer together, and the penultimate one bears a single larger spine in opposition to the terminal claw.

The radials are partially visible. The IBr$_1$ are twice as long as the radials, nearly oblong, and quite free laterally. The IBr$_2$ (axillaries) are pentagonal with a wide distal angle, and are nearly twice the length of the IBr$_1$. The middle line of the articulation between the IBr$_1$ and IBr$_2$ is marked by a slight spiny tubercle, and there is a similar but less marked tubercle on the articulation between the first two brachials.

The 10 arms are about 150 mm. long and are composed of 150+ brachials. The first brachials are rhomboidal, and are almost completely united laterally. The second brachials are longer and more wedge-shaped. These two brachials, and the axillaries, have irregular blunt processes on their outer edges. The next four or five brachials are transversely oblong. The following ones are longer, sharply wedge-shaped, and overlapping. Toward the ends of the arms they become blunter and squarer. The raised distal edges of all the brachials are fringed with short spines.

The first syzygy is between brachials 3+4 and the next is usually between brachials 8+9 or 9+10; after this the intersyzygial interval may be from 4 to 19 muscular articulations, being usually 4 or 5 in the lower parts of the arms and 7 or 8 in their outer portions.

The lower pinnules are stiff and styliform, consisting of about 15 long cylindrical and overlapping segments with expanded and spiny distal edges. P$_2$ is slightly longer than P$_1$, and those following gradually diminish in stoutness and stiffness, but increase in length and in the number of segments. Those on the outer parts of the arms reach nearly 20 mm. in length and consist of about 30 elongated segments with expanded distal ends bearing numerous spines the outermost of which are much longer than the rest.

The disk is 7 mm. in diameter, naked and much incised. Sacculi are moderately closely set along the pinnule ambulacra.

The color in alcohol is dark reddish brown.

Hartlaub in 1891 noted that P$_a$ is absent in this specimen as was kindly determined for him at his request by Dr. R. Horst of the Leyden Museum.

I examined this specimen at the Leyden Museum in 1910. The cirri are XIII, 53, 55, 56, 57, 58, and 59, long and comparatively slender, tapering slightly in the distal half. The longer proximal segments are slightly (about one-third) longer than broad. P$_a$ is absent. The IBr$_1$ are short, three times as broad as long. The IBr$_2$ (axillaries) are also short, twice as broad as long. The synarthrial tubercles are small, but well marked, with the proximal half (on the IBr$_1$) more or less spinous. P$_1$ is slightly stiffened, about two-thirds as long as P$_2$, and is composed of about 15 segments which become about as long as broad on the third and distally three times as long as broad. P_2 is enlarged and greatly stiffened. P_3 is slightly larger than P_2, but is similar to it. The following pinnules as far as P_6 or P_8 are similar but slowly decrease in length and stoutness. The pinnules succeeding are only slightly stiffened. The distal pinnules are very long and slender, with about 27 segments. P_1 is rather strongly prismatic, and the following pinnules are prismatic for a diminishing distance basally.

Notes.—The specimen from Lord Howe Island is without cirri. The very stiff lower pinnules reach a length of 23 mm. (P_2). The arms were probably about 120 mm. long. There were XVIII cirri, arranged in one and a partial second irregular marginal row. The dorsal pole of the centrodorsal is deeply concave. The synarthrial tubercles are but slightly marked. In the proximal portion of the arms there is a faint low rounded median carination. P_1, which is not stiffened like the pinnules succeeding, is only half as long as P_2.

Prof. Torsten Gislén gave notes on three specimens from Fiji. In one the centrodorsal is discoidal, 5 mm. in diameter, with the bare dorsal pole 3 mm. across with its margin somewhat raised. The cirri are XX, 55–58, from 30 to 35 mm. long. The first twenty segments are from two to three times as broad as long, slightly constricted centrally, with the distal dorsal edge progressively more and more serrate, developing into a transverse spiny crest. This crest, which in the beginning has several points, from about the twentieth segment onward gets two dorsal spines. On the twentieth-twenty-fifth segments these two spines are close together, later becoming widely separated, standing at the dorsolateral margins of the segments; they do not approach and fuse into a single dorsal spine until some few segments before the penultimate. The 10 arms are mostly broken; loose arms have a length up to 170 mm. The arm bases are without ventrolateral flanges. Small and indistinct synarthrial tubercles are present. The distal ends of the brachials are a little everted and finely spinous. The distal intersyzygial interval is usually from 6 to 10 muscular articulations. P_1 is 7-8 mm. long with 10 segments, stiffened, though usually less so than the succeeding pinnules. P_2 is 13–13.5 mm. long with 11 or 12 segments. P_3 is 12.5–14 mm. long with 13 segments. P_4 is 11.8 mm. long with 13 segments. P_5 is 11.3 mm. long with 13 segments. The first and second segments of the proximal pinnules have a moderate flange on the outer side. The distal pinnules are 17 mm. long with 26 segments. The disk is very deeply incised, and measures 6 by 15 mm. The color is violet-brown. the proximal pinnules and a mediodorsal zigzag band on the arms brighter.

In another specimen from Fiji the cirri have 53–60 segments, and are about 35 mm. long; the longest segments are from one-third again as broad as long to as long as broad. The arms are broken. P_1 is 6.5–7 mm. long. P_2 is 10–12 mm. long. P_3 is 13 mm. long. P_4 is 12.5 mm. long.

The third specimen from Fiji has the cirri up to 39 mm. long with 58–60 segments. The arms are broken. P_1 is 9 mm. long with 11 segments. P_2 is 13 mm. long with 14 segments. P_3 is 14.5 mm. long with 15 segments. P_4 is 14 mm. long with 13 segments. None of the cirrus segments are as long as broad.

Professor Gislén says that in the first and third specimens from Fiji the longest cirrus segments are slightly broader than long, in the second specimen as long as broad, thus a little shorter than in *C. perspinosa*, but longer than in *C. vepretum*. The cirri in the specimens from Fiji are a little shorter in proportion to the arm length than in other specimens of *perspinosa* (up to 39 mm. with 60 segments, arm length up to 170 mm., as against 43–50 mm. with 53–63 segments and arm length 150 mm.), but Gislén rightly considered this difference unimportant. As seen from the descriptions, P_2 and P_3 are a little variable in relative length, though P_3 is generally the longer.

The specimen from Port Denison was described as a new species, *Antedon lovéni*, by Prof. F. Jeffrey Bell in the following terms:

> Centrodorsal large, as large as the disk, excavated in the centre, with about 20 cirrus-sockets (cirri lost).
>
> First radials just visible, second [IBr$_1$] oblong with a convex median protuberance along their distal edge; axillary [IBr$_2$] pentagonal, not a syzygy. Ten arms. First brachials wider without than within, in contact, with a convex median protuberance along their distal edge; the second with sides a little more regular; the third almost square, a syzygy. The fourth to seventh joints a little wider than long; eighth or ninth a syzygy. The succeeding joints wedge-shaped, with their free margins a little overlapping and slightly toothed. About 5–8 joints between the succeeding syzygies.
>
> The earlier pinnules are extraordinarily stiff; the first, which is on the second brachial, is much shorter than the second or third, which are of about the same length and made up of rather less than 20 joints, most of which are longer than wide, and have their distal edge enlarged and slightly denticulated. There are 10 or 12 stiff pinnules; the succeeding ones are shorter, and then again longer.
>
> Arms more than 120 millim. long; disk not more than 7 millim. in diameter. The radials and the earlier brachials have their infero-lateral edge produced into a kind of ledge. The more proximal joints have the appearance of being tuberculated, and there is a faint median dorsal ridge; at the sides they are compressed.
>
> Colour, dark slate.
>
> The stiff pinnules, the long arms, and the small disk are very striking characters in this species.

For figures of this species Bell refers to plate X, figs. A, *a–e*. The reference should have been to figs. C, a–e. On plate X there are two figures lettered B, but none lettered C. The figure at the top of the plate lettered B should have been marked C.

Carpenter noted (1888) the absence of P_a in the unique specimen of *Antedon lovéni*, remarking that this seems to have escaped Bell's notice, for he made no mention of it. He said further that Bell's figure is also incorrect, for the pinnules of the second, fourth, and sixth brachials (P_1, P_2, and P_3) are represented as being placed on the inner instead of on the outer side of the arm. A similar error occurs in the figure of *Antedon pumila* (=*Compsometra lovéni*) on the same plate, in which the first, second, fourth, and sixth, etc., brachials are all represented as bearing pinnules on the inner side of the arm, an arrangement which never occurs in any crinoid.

The specimen from Binongko has the arms 150 mm. long. The cirri are 40–43 mm. long with 50–54 segments.

The specimen from Ternate has the arms 170 mm. long. The cirri are 50 mm. long with 48–53 segments of which the longest are slightly longer than broad. P_3 is about as long as P_2.

In the specimen from Amboina the cirri are XII, 56–65, exactly resembling those of the type specimen from Jobi. Indeed, the whole animal most closely resembles that from Jobi.

The specimen from Banda has the arms 130 mm. long and the cirri X (with some rudimentary), 56–63, from 45 to 50 mm. long. The color is black tinged with violet.

On the specimen from *Siboga* station 40 only a single undeveloped cirrus with 49 segments remains.

Remarks.—The following species, *C. vepretum*, is probably merely the northern race of the species under consideration. But our material as yet is insufficient to enable us to form any definite conclusions.

Localities.—Lord Howe Island, east of New South Wales [A. H. Clark, 1911] (1, Australian Mus.).

Fiji; reef south-southeast of the islet at Bau, Viti Levu; Dr. Sixten Bock, July 1917 [Gislén, 1940].

Alert; Port Denison, Queensland; 5–7 meters [Bell, 1882; P. H. Carpenter, 1883, 1884, 1888; von Graff, 1884; Hartlaub, 1891; Walther, 1894; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Island of Jobi (or Jobie), in Geelvink Bay, New Guinea; von Rosenberg [P. H. Carpenter, 1881, 1883, 1888; Bell, 1882; Hartlaub, 1891, 1912; A. H. Clark, 1907, 1909, 1911, 1912] (1, L. M.).

Binongko, Toekang Besi Islands; 6–10 meters; *Willebrord Snellius*, March 7–10, 1930 [A. H. Clark, 1936] (1, L. M.).

Ternate; 2–4 meters; *Willebrord Snellius*, June 6, 1930 [A. H. Clark, 1936] (1, L. M.).

Amboina; Ludeking [A. H. Clark, 1911, 1912] (1, L. M.).

Siboga station 240; anchorage at Banda; 9–36 meters; black sand and coral; lithothamnion bank in 18–36 meters; November 22 to December 1, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 149; Fau anchorage and lagoon, western coast of Gebé Island; 31 meters; coral; August 10–11, 1899 [A. H. Clark, 1918] (fragment, Amsterdam Mus.).

Siboga station 40; anchorage off Pulu Kawassang, Paternoster Islands, north of Sumbava; 12 meters; coral reef; April 2, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.)

Doubtful or erroneous localities.—Port Jackson, New South Wales [A. H. Clark, 1911, 1912] (small arm fragment, Austr. M.).

Amboina; Dr. J. Brock [Hartlaub, 1891; A. H. Clark, 1909, 1912, 1918]. The specimen on which this record is based represents *C. vepretum*.

Geographical range.—From Fiji, Lord Howe Island (east of New South Wales), and Port Denison, Queensland, northward to Jobi Island, in Geelvink Bay on the northern coast of New Guinea, and Gebé Island, between Halmahera (Gilolo) and Waigiu, and westward to the Paternoster Islands, north of Sumbava, Lesser Sunda Islands.

Bathymetrical range.—From the shore line down to 31 (?36) meters.

History.—This species was first described by Dr. P. H. Carpenter in 1881 under the name *Antedon perspinosa* from a specimen from Jobi in the Leyden Museum that had been collected by H. von Rosenberg.

In his list of specific formulae for all the known species of comatulids, published in October 1882, Prof. F. Jeffrey Bell included *Antedon perspinosa*. He also gave the formulae of some new species from the Australian seas full descriptions of which he hoped to be able to publish at an early date. Although he did not say so, these new species were from the collections of H. M. S. *Alert*. Among the new names were *Antedon insignis* and *A. lovèni*.

In his list of emended formulae published in April 1883, Dr. P. H. Carpenter included *insignis*, *lovéni*, and *perspinosa*, together with 23 other species, under the general formula A.10^{2}.

In the *Alert* report published in 1884 Professor Bell described *Antedon lovéni* in detail and figured it. For it he gave the specific formula he had given for *A. insignis* in 1882; but *Antedon insignis* is nowhere mentioned. Bell noted that the large *Myzostomum* found on *Antedon lovéni* had been named *M. coriaceum* by Dr. Graff; but *M. coriaceum* was described in 1884 from *A. insignis* from the *Alert* collections at Port Denison in 3–4 fathoms.

Dr. Ludwig von Graff in 1887, under the heading *Myzostoma coriaceum*, said that the name *Antedon insignis* (1882) was altered by Bell in the *Alert* report to *A. lovéni*. Professor von Graff told me in conversation in 1907 that all his crinoid names, and the notes on them, were furnished him by Dr. P. H. Carpenter.

In the *Challenger* report on the comatulids published in 1888 Carpenter included *Antedon perspinosa* in the key to the species in the *Milberti* group, but did not otherwise mention it, as it was not represented among the species secured by the *Challenger*. In the key to the species in the *Milberti* group he also included *lovéni*, placing it, together with [*Decametra*] *informis*, in the section characterized by the absence of P_a, *perspinosa* being placed in the section including species with P_a present. He noted that in the *Alert* report Bell gave the name *lovéni* to the species that appeared as *insignis* in his earlier (1882) list, the *lovéni* of this earlier list appearing as *Antedon pumila* in the *Alert* report.

Dr. Clemens Hartlaub in 1891 under the name *Antedon perspinosa* figured and gave notes on a specimen that had been collected by Dr. J. Brock at Amboina. This specimen is more properly referable to *vepretum*. He examined the type specimen of *Antedon perspinosa* in the Leyden Museum giving notes on it also and comparing his specimen from Amboina with it. He noted especially that both specimens lack P_a. He remarked that he regarded Bell's *Antedon lovéni* from Port Denyson (=Denison) as identical with Carpenter's *A. perspinosa*.

In my first revision of the old genus *Antedon* published in 1907, *perspinosa* was placed in the new genus *Cyllometra*. In a footnote the new name *Cyllometra belli* was proposed for *Antedon lovéni* Bell, 1884, not *Antedon lovéni* Bell, 1882. In 1908 I wrote that *Cyllometra belli* was originally proposed as a substitute for *Antedon lovéni* Bell, 1884, not *Antedon lovéni* Bell, 1882; but *Antedon lovéni* Bell, 1884=*Antedon insignis* Bell, 1882; therefore *Cyllometra belli* is a pure synonym of *Antedon insignis* Bell, 1882. In my revision of the family Himerometridae published in January 1909, I removed *perspinosa* to the new genus *Colobometra*, of which I made it the genotype. Later in the same year in a paper on the crinoids of the Copenhagen Museum I compared *Colobometra perspinosa* with the new species *C. vepretum*. In a paper on a third consignment of crinoids from the *Albatross* Philippine expedition published on February 15, 1911, I mentioned the fact that Dr. P. H. Carpenter had overlooked the absence of P_a in describing *Antedon perspinosa*. In 1911 I published notes on the type specimen of *Antedon perspinosa* which I had examined at the Leyden Museum in 1910, and compared it with *C. vepretum*.

In my memoir on the crinoids of Australia published on August 17, 1911, I gave the synonymy of *Colobometra perspinosa*, including under that name Bell's *Antedon insignis* (1882) and *A. lovéni* (1884). I recorded and gave notes on a specimen from Lord Howe Island and recorded a small arm fragment from Port Jackson, New South Wales, the inlet on the southern shore of which lies the city of Sydney. Port Jackson is within the range of the southeast Australian fauna and is well south of the southern limit of the tropical fauna, so that this last locality record is very doubtful. In my memoir on the crinoids of the Hamburg Southwest Australian Expedition published in 1911, I gave a summary of the range of this species in Australia.

In his memoir on the comatulids of the *Blake* expedition published in April 1912, Hartlaub said that he considered my segregation of a number of species of "*Antedon*" under the generic name *Cyllometra* entirely justified. He listed the species that would fall under *Cyllometra*, as originally defined, including in the list *Antedon perspinosa* from Tobie [=Jobi] Island, and *A. insignis* Bell, 1882, from Port Denison.

In my memoir on the crinoids of the Indian Ocean published in 1912 I gave the synonymy and range of *Colobometra perspinosa*. In the synonymy I included Bell's *Antedon insignis* (1882) and *A. lovéni* (1884), and my own *Cyllometra belli* (1907). The localities for the species I gave as Jobie, Amboina, Port Denison, and Port Jackson.

During a visit to the British Museum in 1910 I examined the type specimen of Bell's *Antedon insignis*—the *Antedon lovéni* of the *Alert* report—and in a paper on the crinoids of that museum published in 1913 recorded the fact. In 1915 I discussed in detail the range of this species on the Australian coasts. In my memoir on the comatulids of the *Siboga* expedition published in 1918 I gave a synonymy of *Colobometra perspinosa* and recorded specimens from stations 40, 149, and 240.

Dr. Hubert Lyman Clark in 1921 discussed the range of this species on the coasts of Australia.

In 1940 Prof. Torsten Gislén gave notes on three specimens that had been collected in Fiji in 1917 by Dr. Sixten Bock. He noted that this find extended the range of the genus considerably toward the east, no species previously having been recorded from east of the Solomon Islands (*C. diadema*) and Lord Howe Island (*C. perspinosa*).

COLOBOMETRA PERSPINOSA var. VEPRETUM A. H. Clark

Plate 14, Figure 70; Plate 15, Figure 71

[See also vol. 1, pt. 2, fig. 727 (disk), p. 346.]

Antedon perspinosa (part) Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 85 (specimen from Amboina described), pl. 5, fig. 54.

Colobometra vepretum A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 132 (formation of side and covering plates from the brachials by suture), p. 174 (description; Singapore), p. 177 (comparison with *C. perspinosa*, *C. suavis*, and *C. discolor*), p. 193 (collected at Singapore by Svend Gad); Proc. Biol. Soc. Washington, vol. 23, 1910, p. 7 (comparison with *C. diadema*); Notes Leyden Mus., vol. 33, 1911, p. 188 (compared with *C. perspinosa*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 401 (Singapore); Crinoids of the Indian Ocean, 1912, p. 165 (synonymy; Amboina; Singapore).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (Singapore, No. 6379).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 123 (in key; range); Temminckia, vol. 1, 1936, p. 308 (probably the same specific type as *perspinosa*).—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, p. 14.

Diagnostic features.—The cirri are of moderate length and are composed of 35–53 (usually 40–50) segments of which the longest are usually not so long as broad, rarely slightly longer than broad; P_3 is similar to P_2 and of the same length, rarely slightly longer; the arms are 110–170 mm. long. This is a large species with rather stout cirri of moderate length and a very strong development of spines on the segments of the pinnules and of the cirri, and on the distal ends of the brachials.

Description.—The centrodorsal is discoidal, rather thin, with the bare polar area concave, 3 mm. in diameter. The cirrus sockets are arranged in a single crowded and more or less irregular marginal row or in two closely crowded alternating rows.

The cirri are XX–XXIV, 44–52, comparatively short and stout, tapering rather rapidly in the proximal half and becoming slender distally; none of the component segments are so long as broad. The first segment is twice as broad as long and those following increase in length to the sixth, which is from one-half to two-thirds again as broad as long. The following segments are similar, becoming twice as broad as long again in the distal half of the cirri. The second and following segments are more or less constricted centrally with expanded and somewhat overlapping distal ends which are armed all around with fine spines. Distally this feature becomes less and less marked and finally disappears at about the middle of the cirrus, when the ventral surface of the cirrus becomes perfectly smooth but dorsally the projection of the distal edges of the segments becomes progressively more and more flattened after the tenth or fourteenth resolving itself into a pair of small subterminal spines which become more prominent distally, on the antepenultimate segment being reduced to a single small median spine which may, however, be altogether absent. The opposing spine is much larger than the spines on the preceding segments, triangular in profile with the apex nearly or quite terminal, arising from the entire dorsal surface of the penultimate segment and equal to between half and the whole width of that segment in height.

The distal ends of the radials are even with the rim of the centrodorsal in the midradial line, but in the interradial angles of the calyx the radials are produced anteriorly entirely separating the bases of the IBr_1. The IBr_1 are oblong or slightly trapezoidal, 3 times as broad as long, strongly convex dorsally, with the ventrolateral edges produced into a thin flangelike process. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long or slightly broader, the lateral edges about two-thirds as long as those of the IBr_1 with which they make a very obtuse angle and, like them, provided with a thin flangelike ventrolateral process.

The 10 arms are from 120 mm. to 130 mm. long. The first two brachials are slightly wedge-shaped, about twice as broad as the exterior length, the first interiorly united for the proximal three-fourths thence diverging at approximately a right angle, and furnished with a more or less irregular flangelike process like those on the elements of the IBr series. The first syzygial pair (composed of brachials 3+4) is oblong or slightly longer interiorly than exteriorly, twice as broad as long. The next 4 or 5 brachials are oblong, about twice as broad as long, those succeeding quickly becoming triangular, twice as broad as long, and in the terminal portion of the arm oblong and as long as broad. The first brachials have the middle of the distal edge for a short distance everted and spinous. This eversion rapidly increases in extent on the succeeding brachials until after the eighth or tenth the entire distal edge is produced and armed with fine spines.

Syzygies occur between brachials 3+4, again usually between brachials 9+10 and 14+15, the second often omitted, and distally at intervals of from 5 to 23 muscular articulations. On some arms the third syzygy may be as early as between brachials 11+12, or it may be as late as between brachials 25+26.

P_a is absent. P_1 is 10 mm. long, stiff and moderately stout, with 12 segments of which the first 2 are about as long as broad, the third is slightly longer, and those following increase in length becoming twice as long as broad on the sixth, but shorter again terminally; the last 5 segments have their distal ends armed with very prominent spines. P_2 is 15 mm. long, stouter than P_1, stiff and spinelike, with 15 segments of which the first 2 are about as long as broad, the third is slightly longer than broad, and the following increase in length, from the fifth onward being twice as long as broad or even longer, the last 4 being short again. From the third onward the segments have projecting and very spinous distal ends, especially in the distal half of the pinnule. P_3 is similar to P_2 and of the same length. P_4 is similar but with only the last 2 segments small, 13 mm. in length. P_5 is similar to P_4 and of the same length. P_6 is slightly more slender than the preceding pinnules, but stiff and spinelike like them, 10 mm. long with 14 segments which resemble those of the preceding pinnule. The next 3 or 4 pinnules are similar to P_6, but becoming very slightly more slender and increasing slightly in the number of segments. The following pinnules are slightly longer with more numerous and proportionately shorter segments which in the proximal portion have the ventrolateral edges produced into thin rounded triangular or wedge-shaped processes of which the apex is the anterior angle; distally these processes gradually become reduced to rounded ventral projections of the ventrolateral angle, in the terminal portion disappearing altogether. The distal pinnules are slender, 14 mm. or 15 mm. long with 25 segments which have the distal ends produced and finely spinous as in the preceding pinnules. The production of the ventrolateral edges of the pinnule segments is not found much farther out than the middle of the arm.

The color in alcohol is pinkish white; or, deep violet, the middle of the dorsal pole of the centrodorsal with a spot, the IBr series and proximal half of the arms with a lateral line, of darker.

Notes.—The preceding description is based upon the two specimens collected at Singapore by Svend Gad.

One of the specimens from Bantayan reef, Cebu, has the arms 110 mm. long. The cirri are XVI, 50–53, 40 mm. long. The longest cirrus segments are always broader than long, usually one-third again as broad as long.

The specimen from Singapore in the Berlin Museum collected by Professor von Martens consists of an arm fragment.

The specimen from Amboina recorded by Hartlaub has the centrodorsal with a flat depression at the dorsal pole. The cirri are marginal. The cirri are XVI, 35–48, about 23 mm. long. The segments in the proximal half of the cirri have produced and spiny distal ends, and those in the distal half each bear two dorsal spines. The longest lower pinnules are P_3 and P_4 which are of about equal size, 15 mm. long, and are composed of 16 elongated segments. The segments of the very stiff and elongated lower pinnules have produced and spiny distal ends. The length of the distal pinnules is unusually great, exceeding that of the lower pinnules. P_a is present on four arms. These arms are small and stunted, and are obviously regenerated.

In the specimen from Port Galera, Mindoro, the cirri are XXVI, 53–55, 40 mm. long. The longest segments, the seventh-twelfth, are not quite so long as the proximal width. The arms are 145 mm. long. P_1 is 11 mm. long and is composed of 18 segments of which the first is twice as broad as long, the second is slightly broader than long, the third is as long as broad, the eighth is twice as long as broad, and the eleventh or twelfth and following are three times as long as broad. The pinnule is stiff, but not spinelike, and is more or less flexible in the outer half. The last 6 or 7 segments have a small tuft of spines on the distal edge. The segments in the proximal half have a sharp middorsal crest which is not raised into a carination. P_2 is 15 mm. long with 17 segments, stiff and spinelike, about as stout basally as P_1 but tapering with extreme slowness. The first segment is twice as broad as long, the third is about as long as broad, and the last thee or four are about three times as long as broad. The fourth and following have the distal edge armed with fine spines which soon become long and conspicuous, forming a flaring distal spinous collar which overlaps the base of the segment succeeding. P_3 is 14 mm. long with 14 segments, resembling P_2 but slightly stouter distally. P_4 is 15 mm. long with 15 segments and resembles P_3. P_5 is 16 mm. long with 16 segments and resembles P_4. P_6 is 16 mm. long with 18 segments. P_7 is 15 mm. long with 16 segments. P_5 to P_7 are slightly stouter distally than the pinnules preceding and are composed of shorter segments which are never over twice as long as broad. After P_7 or P_8 the pinnules become more slender with more elongated segments in the outer half.

The specimen from Vatek van Toeal has the arms 170 mm. long. Only a single cirrus remains; this has 52 segments. The longest segments of the best developed cirri are not so long as the width of their expanded ends. P_1 is 14 mm. long with 13 segments. P_2 is 21 mm. long with 16 segments. P_3 is 22 mm. long with 15 segments. P_4 is 20 mm. long with 14 segments. P_5 is 19 mm. long with 14 segments. P_6 is 17.5 mm. long with 15 segments. P_7 is 16 mm. long with 15 segments.

Remarks.—In 1909 I wrote that this species appears to be quite distinct from *C. perspinosa*. It has fewer cirrus segments, all of which are short, none being so long as broad. The cirri are comparatively short, and are stout basally, tapering distally. P_2, P_3, and P_4 are enlarged and spinelike, nearly equal, but P_1 is much shorter and less stiff. The middle and distal pinnules are shorter than they are in *C. perspinosa*, and have the distal ends of the segments but slightly expanded and bearing only minute spines. After an examination of the type specimen of *C. perspinosa* I wrote in 1911 that its proximal pinnules are comparatively slender, not so stout as are those of *C. vepretum*. Further experience has shown that there is really very little difference between these forms. It is probable that they represent geographical races of the same specific type, *perspinosa* in its typical form occurring on the coasts of northern Australia and in the regions adjacent, and *vepretum* farther north, the two intergrading in the vicinity of Amboina.

Localities.—Bantayan reef, Cebu, Philippines; Dr. Lawrence E. Griffin (5, M. C. Z., 385, 393).

Dr. Th. Mortensen's Pacific Expedition 1914–1916; Port Galera, Mindoro; about 9 meters; February 3, 1914 (1).

Singapore; Svend Gad [A. H. Clark, 1909, 1912, 1918] (2, U. S. N. M., 35313; C. M.).

Singapore; Prof. Edouard von Martens [A. H. Clark, 1912, 1918; Hartmeyer, 1916] (arm fragment, Berl. M., 6379 [5351]).

Amboina; Dr. J. Brock, 1884–1885 [Hartlaub, 1891; A. H. Clark, 1909, 1912, 1918].

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Vatek van Toeal; about 1–2 meters; rocky coast; March 27, 1922 (1).

Geographical range.—From the Philippines to Singapore and southward to Amboina and the Kei Islands.

Bathymetrical range.—From the shore line down to about 9 meters.

History.—The first known specimen of this variety was one from Amboina, which was recorded under the name *Antedon perspinosa,* figured, and partially described, by Dr. Clemens Hartlaub in 1891.

In 1909 I described *Colobometra vepretum,* which was based upon two specimens that had been collected at Singapore by Svend Gad. At the same time I noted that Hartlaub's specimen from Amboina appears to belong to this species. The only difference that is apparent on comparing the specimens from Singapore with Hartlaub's figure of his specimen from Amboina is that in the latter the cirrus segments are shown to be slightly longer. In 1911, after an examination of the type specimen of Carpenter's *Antedon perspinosa* in the Leyden Museum, I wrote that the stiffness of P_1, which is composed of elongated segments, appears to separate *perspinosa* sharply from *vepretum,* and to place it in the *diadema* group of species. In 1912 I recorded an arm fragment of this species in the Berlin Museum from Singapore which had been collected by Prof. Edouard von Martens. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Colobometra vepretum* and gave the synonymy and localities.

Dr. Robert Hartmeyer in 1916 corrected the catalog number on the fragmentary specimen from Singapore in the Berlin Museum.

In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *vepretum* in my key to the species of *Colobometra* and gave the range.

In my report on the comatulids of the *Willebrord Snellius* expedition published in 1936 I wrote that specimens identified as *perspinosa* (see page 122) from Binongko and Ternate are intermediate between *perspinosa* and the more recently described *vepretum,* which probably represent the same specific type.

COLOBOMETRA DISCOLOR A. H. Clark

PLATE 15, FIGURES 72–75; PLATE 16, FIGURES 76–79

[See also vol. 1, pt. 1, fig. 350 (cirrus), p. 291; pt. 2, figs. 56, 57 (radial pentagon), p. 33; figs. 480–483 (pinnule tips), p. 269.]

Colobometra discolor A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 640 (description; 14° 04′ 30″ N., 93° 51′ 00″ E.); Vid. Medd. Naturh. Foren. København, 1909, p. 177 (compared with *C. vepretum*); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 543 (*Albatross* stations 5355, 5356; compared directly with the type); Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 269 (off Table Island, Andamans, 15–35 fms.); Crinoids of the Indian Ocean, 1912, p. 166 (detailed description; localities), fig. 25, p. 167.—H. L. CLARK, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 93 (occurs at Ceylon).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 123 (in key; range), p. 124 (synonymy; notes; stations 80, 310), pp. 272, 276 (listed).

Diagnostic features.—P_2 is noticeably longer and stouter than P_3 and the pinnules following; the cirri are of moderate length and moderately slender, and are composed of 29–40 (usually 30–35) segments of which the longest are slightly longer than broad; the arms are 40–105 (usually 45–80) mm. long. This is a medium-sized or rather small and rather spiny species.

Description.—The cirri are XVIII–XXII, 29–40 (usually about 35), 25 to 30 mm. long, slender, resembling those of *C. perspinosa* but with the distal ends of the segments not so strongly spinous.

The radials project slightly beyond the edge of the centrodorsal. The IBr_1 are oblong, slightly over twice as broad as long, with the ventrolateral edges slightly produced into a thin border by which adjacent IBr_1 are in apposition. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long, with the lateral borders somewhat more than half the length of those of the IBr_1 with which they make a straight line, and with the same ventrolateral projections; a slight constriction is usually present just below the lateral angles.

The 10 arms are 80 mm. long, resembling in general those of *C. suavis.*

P_a is absent. P_1 is 6 5 mm. long, small, tapering rapidly to a slender and delicate tip, with 15 or 16 segments. The first segment is twice as broad as long, the second is somewhat longer, the third is about as long as broad, the fourth is similar, and those following very gradually increase in length to about half again as long as broad, becoming again about as long as broad in the terminal four or five. P_2 is 15 mm. long, moderately stout and very stiff and spinelike, with about 20 segments of which the first is about twice as broad as long, the second is slightly longer, the third is nearly half again as long as broad, and the remainder are about twice as long as broad; beginning on the second segment there is a faintly indicated broadly rounded keel running along the middle of the outer side, as on P_1; on the third and following segments the distal dorsal edge projects in the line of this keel in a narrow fringe of spines which broadens on succeeding segments, the spines at the same time becoming longer, and being supplemented by additional spines on the ventrolateral angles of the segments. P_3 is similar to P_2, usually about 1 mm. shorter. P_4 is 10 mm. long, resembling P_2 and P_3, though not quite so stiff, with 15 segments. P_5 and the following pinnules very slowly decrease in length and stiffness, at the same time becoming more slender with the spines on the distal ends of the segments less and less pronounced. P_9 is 8 mm. long and P_{13} is 7 mm. long, each with 15 segments. From this point the pinnules very gradually increase to 10 mm. distally, the distal pinnules being slender and comparatively little stiffened with 20–22 segments, which have moderately everted distal ends armed with fine spines. The distal pinnules are somewhat compressed laterally.

Notes.—The preceding description is based upon the four specimens from *Investigator* station 61, the type locality.

The specimen from *Albatross* station 5355 has the arms 60 mm. long.

One of the two specimens from *Albatross* station 5356 has the arms 95 mm. long and the cirri XIV, 30–40, 25 mm. long; the other is smaller.

These three specimens from *Albatross* stations 5355 and 5356 were compared directly with the type specimen, now in the Indian Museum, Calcutta, and no differences were found.

One of the specimens collected by Dr. Th. Mortensen off Jolo has the arms 105 mm. long and the cirri XVIII, 35–36, 27 mm. long. P_2 is 12 mm. long with 16 or 17 segments. P_3 is 10 mm. long with 13 or 14 segments. P_4 is slightly shorter and more slender than P_3 and is composed of 12 segments. The color in alcohol is lavender with numerous well separated small red brown circular spots, the cirri with spots and occasional narrow bands of darker. In spite of the large size and wholly different coloration, I can not see that this specimen presents any characters differentiating it from *C. discolor*.

The other specimen collected by Doctor Mortensen off Jolo has the arms 85 mm. long and the cirri XIX, 30–36. P_1 is 7 mm. long with 18 segments. P_2 is 11.5 mm. long with 16 segments. P_3 is 11 mm. long with 18 segments. P_4 is 8 mm. long with 12 segments. The color is yellow-brown, becoming purplish on the pinnules and cirri, the last narrowly banded with lighter.

The largest specimen from *Siboga* station 80 has the cirri XV, 36–39, from 18 to 21 mm. long. The cirri are slightly more slender than in the specimens in the type series, with the long proximal segments slightly more elongate. The dorsal pole of the centrodorsal is papillose. P_1 is 5.5 mm. long with 13 segments. P_2 is 9.5 mm. long with 14 segments. P_3 is 8.5 mm. long with 14 segments, and is similar to P_2. P_4 is 6.5 mm. long with 11 segments, and is similar to P_3. P_6 is 7 mm. long. The elongated proximal pinnules are relatively shorter and more recumbent than they are in the type series.

Of the other specimens from *Siboga* station 80, one has the arms 40 mm. long, another has the arms 45 mm. long, and the last has the arms only 15 mm. long with the cirri IX, 12, 3 mm. long, resembling the cirri of the species of *Prometra* in having the segments mostly about as long as broad. On most of the arms P_3 and P_4 have not as yet appeared.

The specimen from *Siboga* station 310 has the cirri with 39 and 48 segments (one of each), 25 and 35 mm. long. The longest cirrus segments are slightly longer than broad. P_1 is 8 mm. long with 19 segments. P_2 is 12.5 mm. long with 18 segments. P_3 is 10.5 mm. long with 14–17 segments. P_4 is 9 mm. long with 15 segments. The lower pinnules are rather less stiffened than usual in this species, and are slightly recurved. The spines on the distal ends of the pinnule segments are shorter and less prominent than is commonly the case. There are no synarthrial tubercles. The size is the same as that of specimens of this species at hand from the Andaman Islands.

The specimen from the Bay of Amboina has the arms 60 mm. long.

Localities.—*Albatross* station 5355; North Balabac Strait; Balabac Light bearing S. 61° W., 16.6 miles distant (lat. 8°08′ N., long. 117°19′15″ E.); 80 meters; coral sand; January 5, 1909 [A. H. Clark, 1911] (1, U. S. N. M., 35367).

Albatross station 5356; North Balabac Strait; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″ E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911] (2, U. S. N. M., 35316, 35323).

Albatross station 5145; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 16° E., 0.85 mile distant (lat. 6°04′30″ N., long. 120°59′30″ E.); 42 meters; coral sand and shells; February 15, 1908 (1, U. S. N. M., 35321).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo, Philippines; about 36–55 meters; sand and coral; March 19, 1914 (2).

Siboga station 80; Borneo Bank (lat. 2°25′ S., long. 117°43′ E.); 40–50 meters; fine coral sand; June 13, 1899 [A. H. Clark, 1918] (4, U. S. N. M., E. 430; Amsterdam Mus.).

Siboga station 310; south of Sumbava (lat. 8°30′ S., long. 119°07′30″ E.); 73 meters; sand with a few pieces of dead coral; February 12, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Bay of Amboina; about 50 meters; stones and sand; March 2, 1922 (1).

Investigator; Port Blair, Andaman Islands [A. H. Clark, 1912] (1, I. M.).

Investigator station 17; off the northern coast of Table Island, Andamans; 27–64 meters; coral; December 8, 1888 [A. H. Clark, 1912] (1, I. M.).

Investigator; Andaman Islands (3, U. S. N. M., 35315 [original No. 19B], 36242, 36243).

Investigator station 61; east-northeast of Preparis Island, Bay of Bengal (lat. 14° 54′ 30″ N., long. 93° 51′ 00″ E.); 75 meters; sand, shells, and coral; November 30, 1889 [A. H. Clark, 1909, 1912] (4, U. S. N. M., 35271, 35272, 35318).

Investigator station 387; off Cape Negrais, Burma (lat. 15° 25′ N., long. 93° 45′ E.); 73–89 meters; sand and coral; November 16, 1909 (1, U. S. N. M., 35347).

Investigator station 175; off northeastern Ceylon (lat. 8° 51′ 30″ N , long. 81° 11′ 52″ E.); 51 meters; sand, shells, and stones; April 20, 1894 [A. H. Clark, 1912; H. L. Clark, 1915] (3, U. S. N. M., 35324; I. M.).

Geographical range.—From the Philippines southward to the Lesser Sunda Islands and the Moluccas, and westward to Ceylon.

Bathymetrical range.—From 42 (?27) to 106 meters; the average of 11 records is 61 meters.

History.—This species was first described by me under the name *Colobometra discolor* in 1909 from four specimens from *Investigator* station 61. In the original description only the latitude and longitude were given, and the former was written lat. 14° 04′ 30″ N. instead of lat. 14° 54′ 30″ N. as it should have been. In a paper on the crinoids of the Copenhagen Museum published later in 1909 I compared *Colobometra discolor* with the new species *C. vepretum.* In a paper on a third consignment of crinoids from the *Albatross* Philippine expedition published by me in 1911, one specimen was recorded from station 5355 and two were recorded from station 5356. Notes on these specimens were given. In a paper on a collection of crinoids made by the Royal Indian Marine Surveying steamer *Investigator* in the seas about India published by me in July 1912, a specimen was recorded from Table Island in the Andaman group. In my memoir on the crinoids of the Indian Ocean published later in 1912, *Colobometra discolor* was redescribed and figured, and in addition to the type series specimens were mentioned from off northeastern Ceylon and from off Port Blair, Andaman Islands. In giving the type locality the mistake made in 1909 was repeated.

In 1915 Dr. Hubert Lyman Clark listed *Colobometra discolor* as among the littoral echinoderms of Ceylon on the strength of the author's record from northeastern Ceylon published in 1912.

In my memoir on the crinoids of the *Siboga* expedition published in 1918, I recorded and gave notes on four specimens from station 80 and on one specimen from station 310.

COLOBOMETRA SUAVIS (A. H. Clark)

PLATE 16, FIGURES 80, 81; PLATE 17, FIGURE 82

Cyllometra suavis A. H. CLARK, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 220 (description; *Albatross* station 5137; fragment from station 5145).

Colobometra suavis A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed); Vid. Medd. Naturh. Foren. København, 1909, p. 177 (compared with *C. vepretum*); Crinoids of the Indian Ocean, 1912, p. 165 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 123 (in key; range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 89 (compared with *C. arabica*, new species).

Antedon suavis HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 381 (listed).

Diagnostic features.—The cirri are composed of 35–40 segments of which the 18–22 preceding the penultimate have a single median dorsal spine instead of paired spines; P_1 is much less stiff than P_2 and is composed of 21 segments none of which are more than very slightly longer than broad; P_2 to P_7 are approximately equal in length and similar, with only a very slight development of spines on the distal ends of the segments; the arms are about 100 mm. long. This is a moderately sized species with only a slight development of spines on the distal ends of the pinnule and cirrus segments and on the distal ends of the brachials.

Description.—This species agrees in its general structure with *C. perspinosa*, but it is much more delicate, the IBr series are more elongated, and the arms, cirri, and lower pinnules are more slender. It entirely lacks the prominent spinous overlap of the pinnule and cirrus segments characteristic of *C. perspinosa*, and the lower pinnules, while stiffened as in *C. perspinosa*, are much more slender than in that species. The cirri are 25–30 mm. long with 35–40 segments and differ strikingly from those of *C. perspinosa* in having the dorsal spines in the distal portion single and median in position instead of paired. The arms are about 100 mm. long.

The color in alcohol is purple, the elements of the IBr series and discoidal lower brachials with a median line of white, the arms, pinnules, and cirri purple with very numerous narrow bands of white.

Localities.—*Albatross* station 5137; in the vicinity of Jolo (Sulu), Philippines; Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908, 1909, 1912, 1918; Hartlaub, 1912] (1, U. S. N. M., 25443).

Albatross station 5145; in the vicinity of Jolo; Jolo Light bearing S. 16° E., 0.85 mile distant (lat. 6° 04′ 30″ N., long. 120° 59′ 30″ E.); 42 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908] (fragments, U. S. N. M.).

History.—This species is as yet known only from a single specimen and fragments of another dredged by the *Albatross* in the vicinity of Jolo in February 1908 and described by me on December 23 of the same year.

COLOBOMETRA ARABICA A. H. Clark

PLATE 30, FIGURE 161

Colobometra arabica A. H. CLARK, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 87 (listed), p. 89 (*Mabahiss* station 10; description; comparisons), pp. 100, 104; pl. 1, fig. 2.

Characters.—The cirri are 20–23 mm. long with 35–40 segments. The three or four segments before the penultimate have single median dorsal spines, these being paired on the segments preceding. P_1 is small and weak, 5 mm. long with 14 or 15 segments. P_2 is 8.5 mm. long with 14 segments. The pinnules following resemble P_2, but slowly decrease in length.

Remarks.—This species resembles *C. suavis* very closely, but it is easily distinguished by the fact that the spines on the cirri are double until near the tip.

Locality.—*Mabahiss* station 10; Red Sea (lat. 13° 31′ 00″ N., long 42° 31′ 00″ E.); 55 meters; September 17, 1933 (1, B. M.).

COLOBOMETRA DIADEMA A. H. Clark

[See vol. 1, pt. 2, fig. 325 (proximal pinnules), p. 227; fig. 728 (disk), p. 346.]

Colobometra diadema A. H. CLARK, Proc. Biol. Soc. Washington, vol. 23, 1910, p. 7 (description; Ugi, Solomon Islands); Rec. Australian Mus., vol. 9, No. 1, 1912, p. 84 (detailed description; Ugi); Crinoids of the Indian Ocean, 1912, p. 165 (synonymy; Ugi); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 123 (in key; range).—GISLÉN, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 18, No. 10, 1940, p. 15.

Diagnostic features.—P_1 is nearly as long as P_2 and is stiff and spinelike with 12 segments of which the fourth and following are about four times as long as broad; P_2 to P_5 are similar, and are either of the same length or decrease slightly in length distally; the cirri are composed of 33–40 segments of which the distal have paired spines dorsally these being replaced by a single median spine on the antepenultimate; the arms are about 70 mm. long; the distal ends of the pinnule and cirrus segments and of the brachials are armed with long and prominent spines.

Description.—The centrodorsal is small and discoidal with the bare dorsal pole 2 mm. in diameter and very slightly concave. The cirrus sockets are arranged in a single slightly irregular marginal row.

The cirri are XI, 33–40, 22 mm. long. The first segment is short, the second is nearly or quite as long as broad, and those following gradually increase in length to the fifth, which is slightly (sometimes as much as one-third) longer than broad. The segments as far as the tenth or twelfth are similar, and those succeeding gradually decrease in length so that the distal segments are about one-third again as broad as long. The second and following segments are rather strongly constricted centrally and are provided with strongly produced and overlapping distal ends which are bordered with prominent spines, both of these features dying away as the segments become shorter. After about the tenth segment the spinous overlap dorsally resolves itself into prominent paired spines which at the tip of the cirri move close together and are replaced on the antepenultimate segment by a single median spine. The opposing spine is large and prominent, triangular, median, about as high as the width of the penultimate segment. The terminal claw is stout and strongly curved, and is but little longer than the penultimate segment.

The radials are short, but extend well up into the angles of the calyx where they entirely separate the bases of the IBr_1. These last are oblong, slightly more than twice as broad as long, with a small spinous tubercle in the middle of the distal edge. The IBr_2 are broadly pentagonal, half again as broad as long, with the lateral edges not quite so long as those of the IBr_1. The inferior inner angle of these ossicles is slightly everted and coarsely dentate. The distal edges of the IBr_2 are everted and finely spinous.

The 10 arms are about 70 mm. long. The first brachials are slightly wedge-shaped, about twice as broad as the exterior length, with the interior sides united for about two-thirds of their length, the distal third diverging at approximately a right angle. The distal edge bears a small spinous tubercle in the center. The second brachials are slightly larger and more nearly oblong. The first syzygial pair (composed of brachials 3+4) is slightly longer interiorly than exteriorly, and is about as broad as the exterior length. The next four brachials are oblong, half again as broad as long, those succeeding becoming very obliquely wedge-shaped, slightly longer than broad, and somewhat longer in the terminal portion of the arms. The brachials have strongly overlapping and spinous distal ends.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 14+15, and distally at intervals of 4–8 (usually 5) muscular articulations.

P_a is absent. P_1 is 10 mm. long, stiff and spinelike, with 12 segments of which the first two are not so long as broad, the third tapers distally and is twice as long as the distal width, and those following are about four times as long as broad. The distal edges of the segments from the third, and especially from the fourth, onward are armed with a frill of long spines. P_2 is 12 mm. long and is similar to P_1 but proportionately stouter; it is composed of 12 segments. P_3, P_4, and P_5 are similar to P_2. P_5 may be 11 mm. long, or there may be no decrease in length in these pinnules. The pinnules following are shorter, more slender, and less stiffened. The distal pinnules have the distal edges of the segments, except the basal, armed with long and prominent spines.

Locality.—Ughi (or Ugi), Solomon Islands, a small island just north of San Christoval or Bauro, the most southeasterly of the group [A. H. Clark, 1910, 1912, 1918] (1, Austr. Mus.).

History.—This species was originally described by me in 1910 from a single specimen that was included in the collections of the Australian Museum which had been sent to me for study. It was described in greater detail in a paper on the crinoids of the Solomon Islands published in 1912. As yet this species is known only from the type specimen in the Australian Musem at Sydney.

Genus CYLLOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, Proc. Roy. Soc., 1879, p. 384; Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 155, and following authors.

Cyllometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, pp. 347, 356 (diagnosis; genotype *Antedon manca* P. H. Carpenter, 1888); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 248 (same); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Himerometridae), p. 212 (occurs in Japan), pp. 309, 318; Proc. Biol. Soc. Washington, vol. 21, 1908, p. 134 (pinnulation), p. 135 (referred to the Himerometridae); vol. 22, 1909, p. 6 (restricted; list of included species); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 362 (deficient pinnulation as in *Comatilia*); Amer. Nat., vol. 43, 1909, p. 580 (pinnulation); Vid. Medd. Naturh. Foren. København, 1909, p. 174 (included in the Colobometridae), p. 193 (probably occurs at Singapore, though not yet found there); Mem. Australian Mus., vol. 4, pt. 15, 1911, p. 725 (absent from Australia), p. 730 (in key); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 25 (relation to *Petasometra*); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 11 (occurs both east and west of Ceylon), p. 12 (occurs in the Persian Gulf, but not in the Red Sea), p. 22 (distribution in detail), p. 57 (in key), p. 156 (original reference; type).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, pp. 370, 371 (discussion).—A. H. CLARK, Unstalked crinoids of the *Siboga* Exped., 1918, p. 111 (in key), p. 114 (key to the included species).—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 77, 80; Zool. Bidrag Uppsala, vol. 9, 1924, p. 84 (syzygies), p. 90 (articulation in the IBr series); Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 26 (probably not tenable as a separate genus), p. 27; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnosis.—A genus of Colobometridae including small and delicate species with 10–30 arms 25–95 (usually 30–45) mm. long; the IIBr and IIIBr series are 2; P_a is almost always absent, and P_1 is absent on the inner arms arising from IIIBr axillaries, and sometimes on the inner arms arising from IIBr axillaries; P_2 is longer and more or less markedly stouter than P_1, and more or less stiffened, with 10–20 (usually 13–18) segments; the cirri have 12–46 segments, most of which bear dorsally paired spines or tubercles.

The individuals of species of this genus with more than 10 arms are easily recognized by the enlarged P_2 and the occurrence of division series with two elements only. The individuals with only 10 arms, however, closely resemble certain species of *Decametra*, to which *Cyllometra* is closely allied.

Geographical range.—From southern Japan and the Riu Kiu and Bonin Islands southward to the Philippine, Kei, and Lesser Sunda Islands, and westward to the Persian Gulf.

Bathymetrical range.—From 22 (?15) down to 329 (?731) meters. Most of the records are from between 90 and 200 meters.

Thermal range.—From 11.61° to 23.78° C. All the thermal records are for *C. manca.*

Remarks.—Dr. Torsten Gislén said it might be worth while to call attention to the fact that the genus *Cyllometra* in many respects approaches the antedonid subfamily Perometrinae. He remarked that it seems very probable that the genus *Cyllometra* cannot be retained as a separate genus, as the only character on which it is based—the possession of more than 10 arms—does not distinguish a natural group within the family Colobometridae. Neither is it advisable for practical reasons, according to him, to retain *Cyllometra*, as such species as *C. disciformis*, *C. manca*, *C. soluta*, and *C. pulchella* often have only 10 arms at a rather considerable size—indeed *C. pulchella* often has only 10 arms when fully grown. Thus 10-armed young or even mature individuals of species of *Cyllometra* might be referred to various other genera of Colobometridae and so give rise to much confusion. It seems therefore most practicable to transfer the species of *Cyllometra* as soon as possible to corresponding 10-armed genera such as *Decametra*, *Oligometra*, etc. Besides, he said, some genera of the family Colobometridae seem to need a thorough revision.

History.—In my first revision of the old genus *Antedon* published in 1907 the new genus *Cyllometra* was established with *Antedon manca* P. H. Carpenter, 1888, as the genotype. In addition to *manca* the new genus included *impinnata*, *informis*, *belli* (new name for *Antedon lovéni* Bell, 1884, not *A. lovéni* Bell, 1882), *perspinosa*, *ruber*, and *tigrina*. The first of these is an unidentifiable young individual; all the others have now been removed to genera subsequently established—*informis* and *tigrina* to *Decametra*, *perspinosa* (of which *belli* is a synonym) to *Colobometra*, and *ruber* to *Erythrometra* (Antedonidae, Perometrinae).

KEY TO THE SPECIES IN THE GENUS CYLLOMETRA

a^1. Over 40 cirrus segments; cirri with 41–46 segments, 20 mm. long; 11–16 arms about 70 mm. long (Mergui Archipelago; 119 meters) ---------------------------------- **prashadi** (p. 136)

a^2. Not more than 35 (very seldom more than 30) cirrus segments.

- b^1. Cirri of moderate length or short, moderately stout, with the longest segments usually from about as long as broad to half again as long as broad, and never more than twice as long as broad (from southern Japan and the Bonin Islands to the Philippine, Kei, and Lesser Sunda Islands, and westward to the Persian Gulf; 22 [?15]—329 [?731] meters) - **manca** (p. 137)
- b^2. Cirri long and slender, with the longest segments about twice as long as the proximal width (Lesser Sunda Islands; 69 meters) ---------------------------------- **gracilis** (p. 169

CYLLOMETRA PRASHADI A. H. Clark

Plate 17, Figures 83–85

Cyllometra prashadi A. H. Clark, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 551 (listed), p. 558 (*Investigator* station 535; description; comparisons), pl. 19, figs. 5–7.

Diagnostic features.—The cirri have 41–46 segments and are 20 mm. long; the 11–16 arms are about 70 mm. long.

Description.—The centrodorsal is broad, thin discoidal, with the dorsal pole 3.5 mm. in diameter, slightly raised in the center, depressed in the peripheral third, and rising again at the bases of the cirri. The cirri are arranged in a single fairly regular marginal row.

The cirri are XV, 41–46 (usually nearer the latter), about 20 mm. long. The first segment is about twice as broad as long or somewhat longer, and those following gradually increase in length to about the eighth or tenth which, with those succeeding, is from one-third to one-half again as broad as long. The cirri taper slightly in the distal third. On the third and following segments the dorsal surface rises considerably from the proximal to the distal end, which is more or less raised in the middle and is armed with fine spines. After the fifth or sixth the segments show dorsally two terminally situated dorsal spines, one on either side. Distally these spines gradually become more slender and longer, and slowly move proximally, on the fourth segment before the penultimate coalescing into a transversely elongate tubercle which on the antepenultimate becomes a simple median tubercle. The opposing spine is low, median, with the apex transversely elongated, forming a short transverse ridge with the crest strongly convex. The terminal claw is somewhat longer than the penultimate segment, and is rather stout and rather strongly curved.

The distal border of the radials is even with the rim of the centrodorsal in the midradial line, but a considerable portion of the anterolateral part of the radials is visible in the interradial angles. The anterolateral angles of adjacent radials are separated by deep and rather broad notches. The IBr$_1$ are very short and bandlike, about eight times as broad as the median length, half again as long laterally as in the median line. The lateral borders are rather strongly convergent, and they are widely separated from their neighbors. A low and broadly rounded median elevation occupies the middorsal line. The IBr$_2$ (axillaries) are very broadly pentagonal, about twice as broad as long. Their lateral borders are about as long as those of the IBr$_1$, with which they make an angle of about 120°. There is a prominent more or less laterally compressed synarthrial tubercle on the articulation between the elements of the IBr series. It is continued proximally into the middorsal elevation on the IBr$_1$ and distally in the form of a similar elevation occupying the proximal half of the axillary. The IIBr series are 2 and resemble the IBr series. The two ossicles immediately following each axillary are united interiorly in their proximal two-thirds, their inner borders then diverging at an angle of 90°.

The 16 arms are about 70 mm. long. The first eight or ten brachials have a distinct, though low and rounded, gablelike median keel, and the brachials following have the distal edge very slightly produced and armed with excessively fine spines.

P_1 is 6 mm. long with 16 segments of which the first is very short, the second is about as long as broad, and those following slowly increase in length, becoming about three times as long as broad terminally. The pinnule is slender and delicate, and tapers gradually from the base to a very slender tip. P_a is absent. P_2 is much stouter and stiffer than P_1, 12 mm. long with 18 segments of which the first is twice as broad as long, the second is about as long as broad, and those following gradually increase in length to the eighth, which is twice as long as broad, and the terminal, which are somewhat longer. The segments in the outer half of the pinnule have the distal ends armed with a conspicuous everted border of fine spines which are longest on the side toward the arm tip. P_3 is 11.5 mm. long with 17 segments, and resembles P_2. P_4 is 7.5 mm. long with 15 segments and resembles the two preceding pinnules, but is more slender, especially in the distal half.

The color in alcohol is purplish brown vaguely blotched with lighter; the cirri are whitish.

Notes.—Three additional specimens have 16+, 14+, and 11+ arms.

Comparisons.—This new species is at once distinguished from all the other species in the genus by the long cirri which are composed of very numerous segments. In the character of its cirri it comes nearest *C. soluta*, but the cirri are longer with more numerous segments and longer dorsal spines, P_3 resembles P_2 instead of being much shorter and more slender, and the distal ends of the pinnule segments are much more spiny.

Locality.—*Investigator* station 535; Mergui Archipelago, west of Tavoy Island (lat. 13°04′30″ N., long. 96°44′ E.); 119 meters; sand and mud; April 17, 1913 (4).

CYLLOMETRA MANCA (P. H. Carpenter)

PLATE 17, FIGURE 86; PLATE 18, FIGURE 87; PLATE 19, FIGURES 91–96; PLATE 20, FIGURES 99, 100; PLATE 21, FIGURE 101; PLATE 22, FIGURES 102–108

[See also vol. 1, pt. 1, fig. 262 (centrodorsal), p. 257; figs. 346–348 (cirri), p. 289; fig. 478 (radial pentagon), p. 363; pt. 2, figs. 54, 55 (radial pentagon), p. 33; figs. 488, 489 (pinnule tip), p. 273; figs. 776–778 (ambulacral deposits), p. 366; pl. 2, figs. 969, 970 (radial pentagon).]

Antedon sp. P. H. CARPENTER, Proc. Roy. Soc., 1879, p. 384; Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 155 (specimen with defective pinnulation [lacking P_a] dredged by the *Challenger*).

Antedon manca VON GRAFF, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 18, 61 (*Challenger* station 192; myzostomes).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 226 (description; station 192; remarks), pl. 44, figs. 2, 3.—BRAUN, Centralbl. Bakteriol. und Parasitenk., vol. 3, 1888, p. 210 (myzostomes; from von Graff).—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 36 (in key), p. 42 (compared with *A.* [*Petasometra*] *clarae*).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 131 (refers especially to *albopurpurea*; considered as including *disciformis* and *clarae*).—HAMANN, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 34 (identity).

Antedon disciformis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 228 (description; Zebu reefs); pl. 4, figs. 2, *a–d*; pl. 39, fig. 4.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1. 1891, p. 36 (in key); p. 42 (compared with *A.* [*Petasometra*] *clarae*); Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 142 (articular faces of the radials compared with those of *A.* [*Florometra*] *tanneri*).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 131 (considered as a synonym of *manca*); Crinoids of the Indian Ocean, 1912, p. 34 (identity).

Cyllometra manca A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 350 (extraordinary variation [but here considered as including *disciformis*, *clarae*, and *albopurpurea*]), p. 357 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 239 (compared with *C. albopurpurea*); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 226 (arm structure compared with that of *C. anomala*); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 221 (*Albatross* station 5213).—H. L. Clark, Bull. Mus. Comp. Zool., vol. 51, No. 11, 1908, p. 279 (Uraga Channel, 20–30 fms.; size; color).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 399 (*Albatross* stations 5154, 5212); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 146 (ray and arm structure compared with that of *C. soluta*); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 543 (*Albatross* stations 5356, 5369); Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 35 (compared with *C. gracilis*); Crinoids of the Indian Ocean, 1912, p. 34 (identity), p. 156 (synonymy; range); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 34 (published reference to specimens in the B. M.; *Challenger* station 192; comparison with *disciformis* and *albopurpurea*); Unstalked crinoids of the *Siboga* Exped., 1918, p. 115 (in key; range), p. 116 (references; notes; station 305), p. 276 (listed).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (47 m.), p. 6 (Kiu Shiu and Goto Islands), pp. 7, 79, 80 (Bock's station 19; detailed notes), pp. 83, 89, 181 (listed), figs. 66, 67, p. 88; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 2 (Mortensen's stations 9, 14; 162 m.), p. 25 (stations 9, 14; notes; comparisons), p. 68 (listed); Ark. Zool., vol. 19, No. 32, 1928, p. 6, No. 21 (notes on specimens in the B. M.).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 641 (Rotti Strait; 100 fms.).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 25.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (range), p. 103.—Mortensen, Danish Scientific Investigations in Iran, pt. 2, 1940, pp. 56, 57 (from A. H. Clark).

Cyllometra albopurpurea A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 239 (description; *Albatross* station 5095), p. 309 (various localities in Sagami Bay and Tokyo Gulf); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 226 (arm structure compared with that of *C. anomala*); vol. 22, 1909, p. 6 (listed), p. 146 (arm structure compared with that of *C. soluta*); Vid. Medd. Naturh. Foren. København, 1909, p. 178 (various localities; descriptions of specimens); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 400 (Japan); Crinoids of the Indian Ocean, 1912, p. 158 (Liu Kiu Islands and southern Japan; range); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in east Asia); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 34 (Inland Sea; characters of the specimens); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga* Exped., 1918, p. 115 (in key; range).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (163–182 m.), p. 6 (Bonin Islands), p. 7, p. 78 (?Bock's station 33), p. 82 (stations 53, 59; detailed notes), p. 183 (listed), figs. 64, 65, p. 88; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 2 (Mortensen's station 19; 144–216 m.), p. 25 (station 19; notes), p. 69 (listed).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 649.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 22, 25.

Cyllometra anomala A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 225 (off Nipon); vol. 22, 1909, p. 6 (listed); Vid. Medd. Naturh. Foren. København, 1909, p. 178 (locality); Crinoids of the Indian Ocean, 1912, p. 158 (synonymy; locality); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 649.

Cyllometra soluta A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 146 (description; Straits of Ormuz, 48–49 fms.); Crinoids of the Indian Ocean, 1912, p. 157 (synonymy; detailed description; Straits of Ormuz, 48–49 fms.; ?Kurrachi), fig. 22, p. 157; Unstalked crinoids of the *Siboga* Exped., 1918, p. 115 (in key; range).—Gislén, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 26.—A. H. Clark, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 559 (compared with *C. prashadi*); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (synonym of C. *manca*).

Cyllometra disciformis A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 34 (identity), p. 158 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 34 (published reference to specimens in the B. M.; locality; cirrus characters); Unstalked crinoids of the *Siboga* Exped., 1918, p. 114 (in key; range), p. 116 (discussion; *Albatross* stations 5213, 5212, 5356, 5369, 5154 Cebu reefs).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (162–728 m.), p. 5 (Sagami Bay), p. 6 (Bonin Islands), p. 7 (previous records), p. 9, p. 77 (Bock's stations 12, ?33, 35; detailed notes), p. 84, pp. 180, 181 (listed), figs. 68, 69, p. 88; Zool. Bidrag Uppsala, vol. 9, 1924, p. 41 (measurements), pp. 44, 79; Ark. Zool., vol. 19, No. 32, 1928, p. 6, No. 20 (notes on specimens in the B. M.); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Antedon albopurpurea Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 381 (listed).

Antedon anomala Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 381 (listed).

Cyllometra pulchella Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (136–163 m.), p. 6 (Kiu Shiu and Goto Islands), pp. 9, 10 (constancy of characters), p. 84 (Bock's stations 6, 12, 13, 16, 17; detailed notes), pp. 110, 131, 180 (listed), p. 181, figs. 133–140, p. 134, pl. 1, fig. 9; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 20, 21 (Mortensen's station 10; abnormal arm), p. 22 (distal arm branching), p. 285 (Kiu Shiu, about 200 m.; details), p. 286; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 2 (occurrence of IIBr series; Mortensen's stations 7, 9, 10, 11; [0–] 135–180 m.), p. 23 (stations 7, 10; notes), p. 25 (comparison with *C. albopurpurea*), pp. 26, 68 (listed); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Petasometra anomala Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 27.

Diagnostic features.—The cirri have usually 18–26 (most commonly about 21–22) segments, and are most frequently 8–9 mm. long; the longest cirrus segments are from about as long as broad to half again as long as broad; the 10–30 arms are usually 25–95 (most commonly 30–45) mm. long.

Description.—The centrodorsal varies from a thin disk to a flattened hemisphere, being usually a moderately thick circular or more or less pentagonal disk up to 4.5 mm., but usually between 2 and 3 mm. in diameter, with sloping sides and the usually flat, but sometimes slightly convex or slightly concave, dorsal pole from 1 to 3, usually about 2, mm. in diameter. The cirrus sockets are arranged in from 1 to 2 more or less irregular crowded and more or less alternating rows.

The cirri are XV–XXXI (usually between XX and XXVIII), 12–35 (usually 18–26 and most commonly about 21–22), from 5 to 21 (usually between 7 and 11 and most commonly 8 or 9) mm. long. The first two or three segments are broader than long, the third or fourth, or both, is about as long as broad, the next is somewhat longer, and those following vary from about one-third again as broad as long to twice as long as broad, being usually slightly longer than broad; the distal segments are shorter again, from half again as broad as long to one-third again as long as broad, being usually about as long as broad or slightly shorter. Although usually the segments in the proximal half of the cirri are slightly longer than broad and those in the distal half are slightly broader than long, sometimes all the segments are practically subequal, all being about as long as broad or slightly broader than long. The antepenultimate segment is about as long as broad or a little longer than broad. Dorsal processes usually begin on about the sixth or seventh segment, but may begin as early as the fifth or even the fourth, or as late as the twelfth. These dorsal processes usually take the form of paired dorsal tubercles which most frequently are small and occasionally very small, though sometimes rather high and conspicuous; but not rarely they are at first represented by a simple transverse ridge which later divides into a pair of tubercles, while occasionally there are triple instead of double dorsal tubercles or spines, or rarely the dorsal processes are obsolete on the earlier segments. Usually on about the sixteenth or seventeenth segment, but sometimes as early as the eighth or ninth and sometimes not until about four or five segments before the penultimate, the double dorsal process becomes a single dorsal tubercle or short spine which usually decreases in size on the outermost segments and may disappear on the antepenultimate. The segments in the proximal half of the cirri are usually more or less constricted basally. The opposing spine is considerably larger than the spines on the segments immediately preceding, its height equaling from one-third to two-thirds the width of the penultimate segment, and being most commonly about one-half. The terminal claw varies from as long as to half again as long as the penultimate segment and is curved and sharply pointed.

The radials are usually visible as narrow bands beyond the rim of the centrodorsal, but they may be wholly concealed by the centrodorsal, visible only in the interradial angles, or even visible as broad bands; they are laterally united in the proximal half or more. The IBr_1 are from one-third again to five or even six times as broad as long, being usually three or four times as broad as long. Their lateral edges are usually slightly convergent, but may be almost or quite parallel, and are laterally free. The middorsal line is commonly smooth, but may bear a slight and obscure median carination. The IBr_2 (axillaries) are broadly pentagonal, from one-third again to three or even four times as broad as long, being usually from half again to twice as broad as long, and roughly about twice as long as the IBr_1, Their lateral borders make a very obtuse angle with those of the IBr_1. They may bear a weak median carination. The IIBr and IIIBr series are 2, the latter being developed only on the outermost sides of the postradial series so that the maximum number of arms on a postradial series is 6, arranged in 2, 1, 1, 2 order. The $IIBr_1$ are from half again to twice as broad as long and may be nearly oblong, or the inner side may be shorter than the outer. The division series are well separated laterally. The ossicles immediately following each axillary are interiorly united. Slight synarthrial tubercles are usually, though not always, present; rarely the synarthrial tubercles are well developed.

The arms vary from 10 to 30 in number. Of 593 specimens examined, 124 have 10 arms; 61 have 11 arms; 77 have 12 arms; 51 have 13 arms; 23 have 14 arms; 19 have 15 arms; 20 have 16 arms; 25 have 17 arms; 20 have 18 arms; 26 have 19 arms; 122 have 20 arms; 12 have 21 arms; 7 have 22 arms; 1 has 25 arms; 3 have 26 arms; 1 has 29 arms; and 1 has 30 arms. Thus slightly over two-fifths of the individuals have either 20 arms (21 per cent) or 10 arms (21 per cent), and only 62 (10 per cent) have 14–16 arms. The arms vary from 25 to 95 mm. in length, being most commonly between 30 and 45 mm. long (about 44 per cent of the specimens), though frequently up to 80 mm. The arms are smooth, and are composed of 100–120 or more brachials. The first brachials are about twice as broad as long, and are basally united interiorly. The first 5 to 7 or 8 brachials are oblong, and those following are obliquely wedge-shaped or triangular, about as long as broad, later slowly becoming oblong again and terminally half again as long as broad with swollen articulations. There are 18–20 brachials for each 10 mm. of arm length, or 15 or 16 if the syzygial pairs are counted as units.

Syzygies occur between brachials 3+4, 9+10 (sometimes between brachials 10+11 or 11+12), from between brachials 13+14 to between brachials 15+16 (usually between brachials 14+15), and from between brachials 17+18 to between brachials 19+20 (usually between brachials 18+19); on arms arising from a IIBr or IIIBr axillary the second and sometimes also the third syzygy is omitted. The distal intersyzygial interval is from 2 to 10 muscular articulations, varying in different individuals, or sometimes on different arms, from 2 or 3 to 7–10 (usually 9 or 10); it is most commonly 3 or 4 muscular articulations on arms arising from a IBr axillary, and 7–10 muscular articulations on arms arising from a IIBr or IIIBr axillary.

P_a is usually absent, but occasionally present on one, two, or a few arms, and in rare cases may be present on as many as half the arms. P_2 and P_b are longer and stouter—often very much stouter—than the other pinnules, though P_3 and P_c sometimes approach them more or less closely in length and stoutness. The earlier segments of these pinnules may be smooth, or they may be slightly carinate on the distal side. The longest segments of P_2, P_b, P_3, and P_c are usually between two and three times as long as broad, and, while they may be smooth, or almost smooth, they are commonly more or less sharply prismatic with serrate or spiny distal ends that rarely are produced into processes suggesting those on P_2 in certain forms of *Oligometra serripinna.*

P_1 is from 2 to 6 (usually from 3 to 4) mm. in length and consists of from 6 to 18 (usually 10–15) smooth segments most or all of which are somewhat longer than broad, those in the distal half being usually about half again as long as broad. P_1 is always absent on the inner of the two arms arising from a IIIBr axillary, and sometimes also on the inner arms borne on a IIBr axillary, but it is sometimes present on the latter, and it is always present on the two outermost arms arising from each postradial series. When present on an inner arm from a IIBr axillary P_1 is usually smaller with fewer segments than its fellow on the outer arm from the same axillary. Though usually slightly stiffened, P_1 may be weak and flexible, or considerably stiffened.

P_2 is longer and more or less, though sometimes not much, stouter than P_1; it is sometimes twice as long as P_1 and may be much stouter, but usually it is from about one-quarter to one-half again as long as P_1 and proportionately stouter. It is more or less strongly stiffened, and may even be almost spinelike. It varies from 3.5 to 12 mm. in length, being usually from 4 to 6 mm. long, and is composed of 10–20 (most commonly 13–17) segments of which the first is broader than long or about as long as broad, the second is about as long as broad or slightly longer, the third is nearly or quite twice as long as broad, and those following progressively increase in length, reaching a length of from three to four or more times the width distally. The segments are often more or less strongly prismatic, and the distal ends are usually, though not always, armed with more or less conspicuous spines, especially at the prismatic angles. P_b resembles P_2 and is similar to it though usually somewhat smaller. It varies from 2.2 to 5.5 mm. in length, being usually between 3.5 and 5.5 mm. long, and is composed of 9–16 (usually 12–14) segments. P_3 is usually more or less smaller than P_2, sometimes being not even half so large, even smaller than P_1; but it is occasionally nearly or quite equal to P_2, and in rare cases may even be longer and stouter. It is from 1.9 to 8 (most commonly from 2 to 4) mm. long, and is composed of 7–18 (usually 9–12) segments. P_c resembles P_3 and is shorter than P_b. In one case it is 4 mm. long with 12 segments. P_4 is commonly nearly or even quite as short and small as P_5, these being the smallest pinnules on the arm. When P_3 is very short, P_4 may be of the same length, though it is usually shorter, and often much shorter. It is from 2 to 5 (most commonly between 2.5 and 3) mm. in length, and is composed of 9–15 (usually 10–12) segments. In contrast to the pinnules immediately preceding, it is always smooth.

The distal pinnules are from 3.5 to 8 (usually about 5) mm. long, and are composed of 14–22 (most commonly about 18) segments of which the first two are short and broader than those succeeding, the second with a more or less marked distal keel, the third is about as long as broad, and those following are long and slender, from two to three times as long as broad. The terminal segment is provided with microscopic dorsal hooks.

The disk is from 3 to 10 (most commonly from 4 to 8) mm. in diameter, and is naked and smooth and very deeply incised. Sacculi are very abundant on the arms and pinnules.

Notes.—One of the specimens from Tokyo Bay in 15–22 meters, with 20 arms, is large and richly colored.

The specimen from Tokyo Bay in 24 meters in the Museum of Comparative Zoology has 20 arms.

The specimen from the Uraga Channel in 36–55 meters in the U. S. National Museum has 20 arms. According to Dr. Hubert Lyman Clark the one in the Museum of Comparative Zoology is about 90 mm. in diameter—that is, has an arm length of about 45 mm. The color of the latter in alcohol is pale purple, the arms banded with whitish.

The example from the Uraga Channel in 46 meters has 13 arms.

The specimens from the Uraga Channel in 146 meters are both small. One has 15 and the other has 20 arms.

The three specimens from the Uraga Channel in 150 meters have 18, 19, and 20 arms about 80 mm. long.

The example from the entrance to the Uraga Channel in 135 meters has 18 arms about 60 mm. long.

The specimen from *Albatross* station 5094 has 17 arms and is large and richly colored.

The six specimens from *Albatross* station 5095 are all large and richly colored, and all have 20 arms, which in one are 60 mm. long.

The specimen from *Albatross* station 5071 has 20 arms and is large and richly colored.

The example from *Albatross* station 3701 has 14 arms.

From *Albatross* station 3707 there are 5 specimens with 17 arms, 2 with 18 arms, 5 with 19 arms, 37 with 20 arms, 7 with 21 arms, and 3 with 22 arms—59 in all. The arms are up to 65 mm. in length.

One of the specimen from *Albatross* station 3708 has 20 arms.

The example from *Albatross* station 3713 has 13 arms.

The two specimens from *Albatross* station 3715 both have 20 arms.

From *Albatross* station 3716 there are 7 specimens, one with 17 arms, 5 with 20 arms, and one with 22 arms.

The specimen from *Albatross* station 3717 has 20 arms.

Of the 14 specimens from *Albatross* station 3720 one has 16 arms, 2 have 19 arms, 8 have 20 arms, and 3 have 22 arms.

The specimen from *Albatross* station 3725 has 10 arms.

The 3 specimens from *Albatross* station 3726 at hand have 10, 11, and 13 arms.

Of the 5 specimens from *Albatross* station 3727 one has 10 arms, one has 18 arms, and 3 have 20 arms.

One of the specimens from *Albatross* station 3729 has 16 arms.

The specimens from *Albatross* station 3755 have 18 and 19 arms.

One of the specimens from *Albatross* station 3764 has 12 arms.

The 2 specimens from lat. 35°06′ N., long. 139°42′ E., 55 meters, or lat. 34°59′ N., long. 139°33′ E., 110 meters, are small with 10 and 15 arms.

Of the 11 small specimens from lat. 35°02′ N., long. 138°50′ E., in 100 meters, 4 have 10 arms, 2 have 11 arms, 2 have 12 arms, 2 have 13 arms, and 1 has 14 arms.

One of the specimens from lat. 35°11′ N., long. 139°45′ E., in 91 meters, has 20 arms.

The specimen from lat. 35°13′ N., long. 139°45′ E., in 73 meters, has 20 arms.

Of the 5 specimens from lat. 35°11′ N., long. 138°43′ E., in 55 meters, one has 14 arms, one has 18 arms, two have 20 arms, and one has 21 arms. The last has the single IIIBr series present developed on the outer side of one of the postradial series. On one arm the syzygial pair consisting of brachials 3+4 is repeated, neither bearing a pinnule.

The specimen from lat. 34°59′ N., long. 139°34′ E., in 100 meters, is small with 13 arms.

One of the specimens from near Misaki in 100 meters has 17 arms 60 mm. long.

In the specimen from Bock's station 33, as described by Gislén, the centrodorsal is 0.8 mm. in diameter. The cirri are XX, the longer 5–6 mm. long with 15–18 segments, and those about the dorsal pole 2.5 mm. long with 12 segments. The longest segments are one-third again as long as broad. The fourth-eighth segments have a double dorsal spine, and those succeeding have a single prominence in the middle of the segment. The antepenultimate segment is usually smooth. The opposing spine is in height equal to half the width of the penultimate segment. The terminal claw is as long as the preceding segment. The earlier segments are somewhat constricted basally so that this portion of the cirri has a rather serrate profile. The radials are visible as narrow bands. The IBr_1 are one-third again as broad as long, and are free laterally. The IBr_2 (axillaries) are four times as broad as long. The first brachials are twice as broad as long, and are basally united interiorly. The 10 arms are 25 mm. long. The distal brachials are half again as long as broad, and are smooth. The intersyzygial interval is 3 or 4 muscular articulations. P_1 is 2 mm. long with 6 or 7 segments. P_2 is 4 mm. long with about 10 segments. P_3 is 2.5 mm. long with 7 or 8 segments. P_a is lacking. P_b is 2.5 mm. long with 9 segments, of which the third and following are smooth and from two to three times as long as broad. The distal pinnules are about 3.5 mm. long. The disk is lost. The color is white with violet spots.

In the specimen from Mortensen's station 19, according to Gislén, the centrodorsal is a low hemisphere. The cirri are XVI, 12–15, from 3.7 to 5.7 mm. long. The longest cirrus segments are as long as the distal width. The cirri are arranged in a double row on the centrodorsal. The 14 arms are 35 mm. long. The IBr_1 are one-third again as broad as long. The IBr_2 (axillaries) are as long as broad. P_1 is 2.5 mm. long with 10 segments. P_2 is 3.5 mm. long with 10 segments. P_3 is 1.9 mm. long with 8 segments. P_4 is 2 mm. long with 8 segments. P_a is lacking. Dr. Gislén says that this is a young specimen. It can be distinguished from specimens of *C. pulchella* by the less numerous cirri, and by the slender arms composed of long and very juvenile segments. The elements of the IBr series are also extremely long, and P_1 and P_2 have an equal number of segments.

The specimen from Ito has 20 arms.

The 20 specimens from between Ito and Hatsushima are mostly small or of medium size, the arms of the largest being 75 or 80 mm. long. Three of them have 13 arms, one has 14 arms, one has 15 arms, three have 17 arms, three have 18 arms, four have 20 arms, four have 21 arms, and one has 25 arms. In the specimen with 25 arms there are five IIIBr series, all developed externally. In one of the specimens with 21 arms and in one of those with 18 arms there are two IIIBr series. Single external IIIBr series occur in two of the specimens with 21 arms, and in one each of those with 18 and 17 arms.

Of the 8 specimens from Fukuura one has 12 arms, one has 13 arms, one has 15 arms, one has 16 arms, two have 17 arms, one has 18 arms, and one has 26 arms.

One of the 3 specimens from Iagoshima has 20 arms 65 mm. long. Another has 20 arms 70 mm. long, all the IIBr series being present; the cirri are 16 mm. long and are composed of 31 segments. The third has 21 arms 75 mm. long, there being present one external IIIBr series; the cirri are 16 mm. long with 30 segments.

The specimen from off Sunosaki has 16 arms.

In the specimen from Bock's station 35, as described by Gislén, the centrodorsal is discoidal with the bare dorsal pole 2 mm. in diameter. The cirri are XV, 25–27, from 13 to 15 mm. long, and are arranged in an almost single row on the centrodorsal. The third and fourth segments are about as long as broad, the fifth-seventh are slightly longer than broad, and those following are shorter again, the distal being half again as broad as long. The fifth- (or seventh-) twelfth segments have a small dorsal transverse ridge with an excavation in the middle forming an indistinct double tubercle, and from about the thirteenth onward the segments have a simple dorsal spine which reaches in height one-quarter the width of the segment that bears it. The height of the opposing spine is equal to half the width of the penultimate segment. The terminal claw is about as long as the penultimate segment. The distal edges of the radials are visible beyond the rim of the centrodorsal. The IBr_1 are five times as broad as long, and are free laterally. The IBr_2 (axillaries) are three times as broad as long. The ossicles immediately following the axillaries are interiorly united. The IIBr series are 2. Inconspicuous synarthrial tubercles are present. The 16 arms are 90 mm. long, and are slender, smooth, and well separated basally. The width of the first brachials is 1.1 to 1.2 mm. The first seven brachials are discoidal, and those succeeding are wedge-shaped. The longer side of the distal brachials equals the width. There are 19 or 20 brachials for each 10 mm. of arm length, or 15 if the syzygial pairs are counted as units. Syzygies occur (as an example) between brachials 3+4, 11+12, 17+18, etc., and distally at intervals of 3 or 4 (or 5) muscular articulations. P_1 is smooth, 5.5 mm. long with 15 segments. P_2 is from 9 to 9.5 mm. long with 19 segments of which the fifth-twelfth are from two to two and one-half times as long as broad and bear spiny prominences on the distal ends; the tip of the pinnule is usually smooth. P_3 is from 7 to 7.5 mm. long with 14 or 15 segments, and is similar to P_2. P_4 is 4 mm. long with 12 segments; this and the following pinnules are smooth. The distal pinnules are 8 mm. long with 20–22 segments of which the first and second are short and stouter than those succeeding, the distal end of the second therefore forming a weak notch against the outer segments, which are longer, from 2 to 3 times as long as broad; the last segment is provided with microscopic dorsal hooks. The disk has been thrown off. The cirri and the division series are white. The distal parts of the arms are spotted with red brown. The proximal pinnules are white, the other pinnules light brown-violet with strongly colored sacculi, of which there are about four pairs to each segment.

The specimen from off Yenoshima in 146–283 meters has 20 arms.

One of the specimens from Misuka has 17 and the other has 20 arms.

The 7 specimens labeled Sagami Bay collected by Dr. Haberer are small and of medium size, the largest having the arms 80 mm. long. One has 15 arms, 2 have 19 arms, and 4 have 20 arms.

Three of the specimens from Japan in the Museum of Comparative Zoology collected by Alan Owston have 20 arms 55–65 mm. long. The three others have also 20 arms.

The specimen from off Hondo (Nipon), Japan, in the Copenhagen Museum was described by the author as a new species, *Cyllometra anomala*, in the following terms: The centrodorsal is a thick disk with a broad slightly concave polar area; the cirrus sockets are arranged in two irregular and crowded more or less alternating rows. The cirri are XXX, 21–28 (usually about 25), from 10 to 12 mm. long. The first six or eight segments are not so long as broad, and the remainder are about as long as broad. The dorsal surface of the segments is smooth, rarely in the terminal two or three with a slight trace of a minute central tubercle. The opposing spine is prominent, though small, reaching to not more than about one-third the width of the penultimate segment in height. The terminal claw is rather longer than the penultimate segment, and is moderately curved. The radials are concealed by the centrodorsal. The IBr$_1$ are slightly trapezoidal, very short, four times as broad as long or even rather broader. The IBr$_2$ (axillaries) are about half again as broad as long and, like the IBr$_1$, are free laterally. Seven IIBr series are present, one 2 and the remainder of 4 segments with a synarthry between the first and second and between the third and fourth. The IIBr$_2$, except when axillary, always bears a pinnule. There are three IIIBr series of 2 ossicles each of which the second is not an axillary. The 17 arms are about 55 mm. long. P_a is present on about half of the arms. The color is white, the cirri with narrow bands of light purple, the polar area of the centrodorsal deep purple, the division series and discoidal lower brachials with a median line of purple, the remainder of the arms crossed by purple bands about equal to one brachial in width separated by white bands of the same width.

The three specimens from the Inland Sea are fine examples of the species with 14, 15, and 19 arms from 70 to 80 mm. long.

The specimen from *Albatross* station 4948 is medium sized with 11 arms.

Of the 6 specimens from *Albatross* station 4935 one has 10 arms 40 mm. long; two have 18 arms; one is small with 20 arms; one has 20 arms 70 mm. long; and one has 30 arms.

The 31 specimens from *Albatross* station 4934 all have 20 arms, except one which has 16 arms 50 mm. long.

The specimen from *Albatross* station 4884 has 10 arms 40 mm. long.

The specimen from Mortensen's station 14, according to Gislén, has the cirri XXV, 22–26, from 7 to 10.5 mm. long. The longest cirrus segments are from half again to twice as broad as long. From the sixth segment onward there is a transverse dorsal ridge, transforming into a double dorsal spine which, about four or five segments before the opposing spine, is replaced by a single one. The dorsal spines are relatively insignificant. The 17 arms are 60 mm. long. The intersyzygial interval is 5–7 muscular articulations. P_1 is 5.5 mm. long with 14 segments. P_2 is 7 mm. long with 16 segments. P_3 is 4.5 mm. long with 11 segments. The disk is naked and much incised, 4 mm. in diameter. The color is mottled violet and white.

The specimen from lat. 33°00′ N., long. 129°24′ E., in 55 meters, is small, with 10 arms.

Of the 12 specimens from near Hirado Island in 73 meters 8 are small with 10 arms, one is medium sized with 10 arms, one is small with 11 arms, one is small with 12 arms, and one is medium sized with 20 arms.

The specimens from *Albatross* station 4902 have from 17 to 20 arms.

The specimens from *Albatross* station 4903 have mostly 20 arms.

The specimens from *Albatross* station 4895 are all large with 11, 16, and 18 arms 40 mm. long.

The three specimens from *Albatross* station 4904 have 10, 12, and 20 arms.

The specimen from *Albatross* station 4894 has 15 arms. The proximal third of the arms is white and the distal two-thirds is purple.

Of the 16 small specimens from lat. 33° 05′ N., long. 128° 22′ E., in 46 meters one has 11 arms and the remainder have 10 arms.

The specimen from lat. 32° 10′ N., long. 128° 20′ E., in 183 meters is a fine example of the species with 19 arms 80 mm. long; the synarthrial tubercles are rather more prominent than usual.

The specimen from lat. 33° 08′ N., long. 129° 20′ E., in 66 meters, is small with 13 arms. The individual is in process of adolescent autotomy, the three IIBr series being only partly grown.

The specimen from lat. 33° 09′ N., long. 128° 18′ E., in 183 meters, has the arms 40 mm. long.

In one of the specimens from Mortensen's station 9, as described by Gislén, the cirri are XV, 17–20, from 6 to 8 mm. long. The 11 arms are all broken. The intersyzygial interval is from (2) 4 to 8 muscular articulations.

In another specimen from Mortensen's station 9 the centrodorsal is 1.9 mm. in diameter with the flattened dorsal pole 1.2 mm. in diameter. The cirri are XIII, arranged in a single row, all broken. There were at least 13 arms 55 mm. long

The IBr_1 are three times as broad as long, and bear a very slight median carination. The IBr_2 (axillaries) are one-third again as broad as long.

In the third specimen from Mortensen's station 9 the cirri are XVI, 16–21, from 4 to 8 mm. long, and are arranged in a single row. The segments are about as long as broad, or shorter. A transverse bi- or tri-dentate ridge arises on the fifth or eighth segment, later transforming into a stout dorsal spine. The 10 arms are 50 mm. long. The distal edge of the radials is even with the rim of the centrodorsal. The intersyzygial interval is 4–6 muscular articulations. P_1 is 3.5 mm. long with 12 segments. P_2 is 6.0 mm. long with 14 segments. P_3 is 4.2 mm. long with 11 segments.

From Dr. Th. Mortensen's station 10 Dr. Gislén recorded 172 specimens. In the 152 specimens examined the number of arms was as follows. Thirty-seven have 10 arms, which are 33, 37, 37, 37, 38, 38, 40, 42, and 43 mm. long in the 9 specimens in which they were measured; 31 have 11 arms, which in 3 are 30, 35, and 45 mm. long; 39 specimens have 12 arms, which in those measured are 36, 40, 40, 40, 45, and 50 mm. long; 23 have 13 arms, which in 3 are 27, 42, and 42 mm. long; 9 have 14 arms, which in 3 are 33, 35, and 40 mm. long; 4 have 15 arms which in 2 are 30 and 47 mm. long; 5 have 16 arms which in one are 31 mm. long; 3 have 17 arms which in one are 37 mm. long; and one has 18 arms 40 mm. long. Gislén said that in no case do IIIBr series occur. The IIBr series are 2, except in three cases (see p. 157). The occurrence of IIBr series shows three different types; a IBr series may bear two IIBr series, or a single IIBr series which may be developed either on the left or the right side. Gislén said that it is not possible to discover a definite preponderance of any one of these three types. In 224 cases investigated, 49 belonged to type 1, with two IIBr series on a IBr axillary; 79 belonged to type 2, with a single IIBr series on the left face of a IBr axillary; and 96 belonged to type 3, with a single IIBr series on the right face of a IBr axillary. Dr. Gislén noted that, curiously enough, the small specimens usually have type 2, while on the contrary the large specimens show type 3. In a specimen with only one IIBr series type 3 is more usual than type 2 (17 cases as against 12). When type 1 occurs and there are division series also on adjacent postradial series, it is usually the postradial series nearest to type 1 that possesses them.

In one specimen from Mortensen's station 10 the cirri are XXV, 24, about 11 mm. long, arranged in two rows on the centrodorsal. The 10 arms are 40 mm. long. The intersyzygial interval in 3–5 muscular articulations. P_1 is 3.2 mm. long with 12 segments. P_2 is 4.8 mm. long with 15 segments. P_3 is 3.1 mm. long with 12 segments. The disk is 3.5 mm. in diameter. The color is yellowish with solitary small violet spots.

In another specimen from Mortensen's station 10 there are XXV cirri. The 15 arms are 47 mm. long. On one postradial series the IBr axillary bears a IIBr series on the left, and on the right an undivided arm with brachials 3 and 4, as well as 1 and 2, united by synarthry, and a pinnule on the fourth brachial. P_1 is 3.5 mm. long with 13 segments. P_2 is 5.7 mm. long with 16 segments of which the distal have small distal tubercles, as in the first specimen described from Bock's station 13. P_3 is 3.5 mm. long with 12–13 segments. The distal pinnules are 4.7 mm. long with 17 segments. The disk has been thrown off. The color is yellowish.

In a third specimen from Mortensen's station 10 the cirri are XXIII, 22, 9 mm. long. There is a weak dorsal thickening on the middle segments. The 17 arms are 35 mm. long. P_1 is 3.2 mm. long with 11–12 segments. P_2 is 4.7 mm. long with 14 or 15 segments. P_3 is 3.5 mm. long with 12 segments. The color is yellowish with small sparse violet spots.

In a fourth specimen from Mortensen's station 10 the cirri have 16–21 segments, and are from 5 to 8 mm. long. The 10 arms are 28 mm. long. P_1 is 2.2 mm. long with 10 segments. P_2 is 3 mm. long with 12 segments. P_3 is 1.8 mm. long with 8 segments. The disk is 2.8 mm. in diameter.

From Mortensen's station 11 Gislén recorded 8 very slender and evidently young specimens probably also belonging to this species.

In one of these the cirri are XX, 8–15, from 2.5 to 6 mm. long. The radials are 4 times as broad as long. The 10 arms are 22 mm. long. P_1 is 2.2 mm. long with 8 segments. P_2 is 2.3 mm. long with 11 segments. P_3 is 1.4 mm. long with 7 segments. P_4 is still shorter. The disk is 1.6 mm. in diameter. There are no orals. Seven of these specimens have 10 arms 15–25 mm. long, and one has 11 arms 30 mm. long. In the smallest specimen the arm length is 15 mm. The disk is half detached. Small orals are present.

In the specimen from Mortensen's station 7 the cirri are XXII, 19–24, from 8 to 12 mm. long. From the fifth segment onward there is an indistinct transverse ridge, slightly thickened laterally. From the eleventh onward there is an unpaired dorsal spine. The 10 arms are 50 mm. long. The color is whitish with numerous small red spots.

The 5 specimens from lat. 32° 12′ N., long. 128° 10′ E., in 183 meters, are all small. Two have 10 arms, one has 11 arms, and two have 12 arms. As is frequently the case in this species, P_a is occasionally present.

In the specimen from Bock's station 12, as described by Gislén, the centrodorsal is discoidal, 1.5 mm. in diameter. The cirri are X, 16–18, from 5.5 to 6 mm. long. The cirrus segments are rather short, the longest being as long as the distal width. From the fourth to the seventh segment there is a transverse ridge, and from the seventh segment onward a single dorsal spine. The IBr$_1$ and IBr$_2$ have a weak longitudinal carination. The 10 arms are all broken. Syzygies occur between brachials 3+4, 9+10, 14+15, etc., thence at an interval of 3 muscular articulations. P_1 is composed of 10 segments, and is shorter than P_2 which is 4 mm. long with 11 segments. P_3 is 3 mm. long with 9 segments. P_5 has 11 segments. P_a is absent The disk has been thrown off.

Another specimen from Bock's station 12 was thus described by Gislén under the name of *Cyllometra pulchella.* The cirri are XVII, 20–24, from 8 to 10 mm. long, and are arranged in a single or double row on the centrodorsal. The radials are visible as broad bands. The IBr$_1$ are twice as broad as long. No synarthrial tubercles are developed. The 12 arms are 40 mm. long. P_1 is 3 mm. long with 9 or 10 segments. P_2 is about 4 mm. long. P_b is 4 mm. long with 9 segments. P_3 is 2.5 mm. long with 9 segments. The distal pinnules are 4 mm. long with about 14 segments.

All the specimens from Bock's station 13, of which there were 33, were referred by Gislén to *C. pulchella.* In one of them the centrodorsal is thick discoidal with the free dorsal pole flat, 1.5 mm. in diameter. The cirri are arranged in two rows. The cirri are XXIV, 25–29, from 10 to 12 mm. long. The first-third segments are broader than long, the fourth is about as long as broad, the fifth is somewhat longer, and those following are about one-third again as long as broad. The antepenultimate segment is a little longer than broad. From about the seventh segment onward there is a slight dorsal transverse carination which on the twelfth-fourteenth becomes a little thickened on either side of the median line, appearing as two inconspicuous tubercles visible only by high magnification. From the fifteenth-twentieth segment onward there is a single swelling which disappears on the outermost segments. The penultimate segment is about as long as broad. The height of the opposing spine varies from one-third to one-half the width of the penultimate segment. The terminal claw is half again as long as the penultimate segment, and is curved and pointed. The radials are visible as very narrow bands beyond the rim of the centrodorsal, and are laterally united in the proximal half. The IBr_1 are from three to four times as broad as long, and are laterally free. The IBr_2 (axillaries) are pentagonal, half again as broad as long; with the IBr_1 they form a small synarthrial prominence with an indistinctly delimited tubercle which is not at all, or only very slightly, prominent in lateral view. The 10 arms are from 40 to 45 mm. long, and smooth. The first brachials are interiorly united basally. The first ten brachials are discoidal, not "wall-sided," and those following have oblique ends. On the articulation between the first two brachials there is a prominence similar to that on the IBr series. Syzygies occur between brachials 3+4, 9+10, 14+15, etc., and distally at intervals of 3 (exceptionally only 2) muscular articulations. P_1 is from 3 to 5 mm. long with 13–15 segments which are smooth and vary from as long as broad to half again as long as broad. P_2 is from 5 to 6.5 mm. long with 16 segments, longer and stouter than P_1, the middle segments often with small distal tubercles. P_3 is from 3 to 4 mm. long with 12 segments, and is smooth like the pinnules succeeding. P_4 is of the same length as P_3 or shorter, with 13 segments. P_5 and the following pinnules are longer again. P_a is absent. P_b is 4.5 mm. long with 14 segments. The distal pinnules are 5 mm. long with about 20 segments of which the first two are short, the third is about as long as broad, and those following are long and slender, about twice as long as broad. The disk is 3 mm. in diameter, incised, smooth, and without calcareous granules. The color as preserved is light brown. In another specimen from Bock's station 13 the centrodorsal is knob-shaped, with the bare dorsal pole 1.3 mm. in diameter. The cirri are XXVI, 20–24, from 8 to 10 mm. long. The terminal claw is about as long as the penultimate segment. The IBr_2 (axillaries) are low hexagons, half again as broad as long. The IIBr series are 2. The 12 arms are 40 mm. long. The first 8 brachials are discoidal. The intersyzygial interval is 2 or 3 muscular articulations. P_1 is 3.5 mm. long with 12 segments. P_2 is 5 mm. long with 13 or 14 segments. P_b is 5 mm. long with 14 segments. P_3 is 3.5 mm. long with 10 segments. P_4 is 3 mm. long with 12 segments. The distal pinnules are 4.5 mm. long with about 15 segments; there is a notch between the second and third segments by which the second seems to form a small prominence. A similar condition, though not so marked, occurs in the specimen preceding.

In another specimen the cirri are XXVIII, 19–22, about 9 mm. long. The 11 arms are 40 mm. long. P_1 is 3 mm. long with 11 segments. P_2 is from 3. 5to 4.5 mm. long with 13 segments. P_3 is 2.5 mm. long with 11 segments. P_4 is 2 mm. long with 9 segments. The distal pinnules are 5.5 mm. long with 16 segments.

In another example from Bock's station 13 the cirri are XXIV, 21–22, 9 mm. long. The 12 arms are 45 mm. long. P_1 is 4 mm. long with 14 segments. P_2 is 6 mm. long with 17 segments. P_b is 5.5 mm. long with 16 segments. P_3 is 4 mm. long with 13 segments. The distal pinnules are 5 mm. long with about 18 segments.

Another specimen from Bock's station 13 has the cirri XXVIII, 19–26, from 8 to 11 mm. long. The 11 arms are 35 mm. long. P_1 is 3 mm. long with 13 segments. P_2 is 5.5 mm. long with 16 segments. P_b is 4 mm. long with 14 segments. P_3 is from 3.5 to 4 mm. long with 12–14 segments. P_4 is 2.5 mm. long with 11 segments. The distal pinnules are 4.5 mm. long with about 18 segments.

In another specimen from Bock's station 13 the cirri are XXVII, the sole remaining cirrus, a young one, being 7 mm. long and having 27 segments. The 12 arms are 40 mm. long. P_1 is 2.5 mm. long with 12 segments. P_2 is 4 mm. long with 12 segments. P_b is 2.5 mm. long with 11 segments. The distal pinnules are from 3.5 to 5 mm. long with 14–18 segments. On some of the arms the syzygies are widely spaced. In all the other specimens from station 13 the distribution of the syzygies is normal. The color is whitish with red spots.

In another specimen from Bock's station 13 the cirri are XXVII, 18–25, from 6 to 11 mm. long. The 12 arms are 35 mm. long. P_1 is 3.2 mm. long with 12 segments. P_2 is 5 mm. long with 12 segments. P_b is 4.2 mm. long with 13 segments. P_3 is 4 mm. long with 12 segments. P_4 is 2.7 mm. long with 13 segments. The distal pinnules are 5 mm. long with 16 segments.

Another specimen from Bock's station 13 has the cirri XXIV, 20–23, from 8 to 9 mm. long. The 11 arms are 35 mm. long. P_1 is 3 mm. long with 11 segments. P_2 is 4.7 mm. long with 13 segments. P_b is 4 mm. long with 12 segments. P_3 is 2.5 mm. long with 11 segments. P_4 is 2.2 mm. long with 12 segments. The distal pinnules are 5 mm. long with 17 segments.

In another specimen from Bock's station 13 the cirri are XXV, 18–23, from 7 to 9 mm. long. The 13 arms are 40 mm. long. P_1 is 3.5 mm. long with 13 segments. P_2 is 6 mm. long with 17 segments. P_b is 5.5 mm. long with 15 segments. P_3 is 3 mm. long with 14 segments. P_4 is 2.7 mm. long with 13 segments. The distal pinnules are 5 mm. long with 18 segments.

In another specimen from Bock's station 13 the cirri are XXXI, 19–25, from 7 to 11 mm. long. The 11 arms are 40 mm. long. P_1 is 3.5 mm. long with 13 segments. P_a is present in one case, 2.2 mm. long with 10 segments. P_2 is 6 mm. long with 16 segments. P_b is 5 mm. long with 15 segments. P_3 is 3.5 mm. long with 11 segments. P_4 is 2.5 mm. long with 10 segments.

Another specimen from Bock's station 13 has the cirri XXI, 20–21, 8 mm. long. The 12 arms are 25 mm. long. P_1 is 2.5 mm. long with 11 segments. As in the specimen preceding, P_a is present in one instance. P_2 is 4.5 mm. long with 14 segments. P_b is 3 mm. long with 10 segments. P_3 is 2.2 mm. long with 10 segments.

In another specimen from Bock's station 13 the cirri are XXIV, 20–25, from 7 to 9 mm. long. The 10 arms are 33 mm. long. P_1 is 3.5 mm. long with 12 segments. P_2 is 7 mm. long with 16–18 segments. P_b is 5 mm. long with 13 segments. P_3 is 3.5 mm. long with 12 segments. P_4 is 3 mm. long with 13 segments.

In 16 additional specimens from Bock's station 13 P_a is exceptionally present. P_1 is in rare cases lacking on the inner arm from a IIBr axillary. Seven of the specimens have 10 arms, three have 11, three have 12, one has 13, one has 14, and one has 15.

In one of the specimens from Bock's station 16 the cirri are XX, 18–24, from 8 to 12 mm. long. The radials are visible as narrow bands. The 11 arms are 45 mm. long. P_1 is 3.5 mm. long with 10 segments. P_2 is 5.5 mm. long with 15 segments. P_b is 4.7 mm. long with 13 segments. P_3 is 4 mm. long with 12 segments. P_4 is 2.5 mm. long with 11 segments. The distal pinnules are 6 mm. long with 18–19 segments.

In the other specimen from Bock's station 16 the cirri are XXVI, 20–25, from 7 to 8 mm. long. The radials are visible as narrow bands. The 13 arms are 30 mm. long. P_1 is 2.8 mm. long with 10 segments. P_2 is 4 mm. long with 13 segments. P_b is 2.5 mm. long with 10 segments. P_3 is 3 mm. long with 9 segments. P_4 is 2 mm. long with 11 segments. The distal pinnules are 5.5 mm. long with about 18 segments.

In one of the specimens from Bock's station 17 the cirri are XVIII, 20–23 (the shortest with 12 segments), from 7 to 8 mm. long. The 10 arms are 35 mm. long. P_1 is 3 mm. long with 10 segments. P_2 is 4.5 mm. long with 14 segments. P_3 is 3 mm. long with 12 segments. The disk is 4 mm. in diameter. The color, as in the specimens preceding, is white with small and rather sparse violet spots.

Two other specimens from Bock's station 17 have 10 arms 28 and 32 mm. long.

In a specimen from Bock's station 6 the free dorsal pole of the centrodorsal is 2 mm. in diameter. The cirri are XXVIII, 22–26, 9 mm. long. The 13 arms are 45 mm. long. The distal intersyzygial interval is 3 or 4 muscular articulations. P_1 is 3 mm. long with 10 segments. P_b is about equal to P_2. P_2 is 5.5 mm. long with 14 segments. P_3 is 3 mm. long with 10 segments. P_4 is from 2 to 3 mm. long with 10–12 segments. The distal pinnules are 5 mm. long with about 18 segments.

In another specimen from Bock's station 6 the cirri are XXV, 19–25, from 10 to 11 mm. long. The 10 arms are 45 mm. long. P_1 is 3. 5 mm. long with 12 or 13 segments. P_2 is 5.5 mm. long with 13 segments. P_b is 5.5 mm. long with 14 segments. P_3 is 4 mm. long with 12 segments. P_c is 4 mm. long with 12 segments. P_4 is from 2.5 to 3 mm. long with 10–12 segments. The distal pinnules are 5.5 mm. long with about 20 segments. The disk is lost. The color, as in most of the specimens preceding, is yellowish with small sparse crimson spots here and there.

In another specimen from Bock's station 6 the cirri are XXIX, 19–23, from 8 to 10 mm. long. The 12 arms are 45 mm. long. The distal intersyzygial interval is 3 muscular articulations. P_1 is 3 mm. long with 11 segments. P_2 is 5 mm. long with 15 segments. P_b is 4.7 mm. long with 13 segments. P_3 is 2.5 mm. long with 10 segments. P_4 is 2.3 mm. long with 10 segments. The distal pinnules are 4.5 mm. long with 18 segments.

Another specimen from Bock's station 6 has the cirri XXVII, 18–27, from 7 to 11 mm. long. The 10 arms are 52 mm. long. The distal intersyzygial interval is 3 muscular articulations. P_1 is 3.2 mm. long with 11 segments. P_2 is 5 mm. long with 16 segments. P_b is 4.5 mm. long with 13 segments. P_3 is 3 mm. long with 11 segments. P_4 is 2.7 mm. long with 11 segments. The distal pinnules are 5 mm. long with 18 segments.

In another specimen from Bock's station 6 the cirri are XXVIII, 19–22, from 7 to 9 mm. long. The 13 arms are 30 mm. long. In arms arising from a IIBr axillary the syzygies are between brachials 3+4, 13+14, 18+19, etc., with an interval of only 2 muscular articulations. P_1 is 3.3 mm. long with 12 segments. P_2 is 6 mm. long with 15 segments. P_b is 5 mm. long with 12 segments. P_3 is 3 mm. long with 11 segments. P_4 is 2.5 mm. long with 12 segments. The proximal pinnules are slightly carinate on the distal side. The distal pinnules are 5 mm. long with about 18 segments. The disk has been lost. The color is more uniformly yellow than in most of the specimens.

In another specimen from Bock's station 6 the cirri are XXIV, 18–22, from 7 to 9 mm. long. The 10 arms are 40 mm. long. The distal intersyzygial interval is 3 or 4 muscular articulations. P_1 is 3 mm. long with 10 segments. P_2 is 5.5 mm. long with 15 segments. P_b is 3.7 mm. long with 10 segments. P_3 is 2.5 mm. long with 10 segments. P_4 is 2.2 mm. long with 10 segments. The distal pinnules are 5 mm. long with 21 segments.

In another specimen from Bock's station 6 the cirri are XXI, 16–19, from 5 to 7 mm. long. The 15 arms are 25 mm. long. The distal intersyzygial interval is 2–3 muscular articulations. The brachials are rather long and juvenile. P_1 is 3 mm. long with 10 segments. P_2 is relatively small, 4 mm. long with 11 segments. P_b is 2.2 mm. long with about 9 segments. P_3 is 2 mm. long with 9 segments. The distal pinnules are 3.5 mm. long with about 15 segments.

According to Gislén the specimen from Bock's station 19 has the centrodorsal large and discoidal, with the bare dorsal pole 2.8 mm. in diameter. The cirri are XXIII, 23–25, from 10 to 11 mm. long, and are arranged in two rows on the centrodorsal. All of the cirrus segments are broader than long; the proximal ones are the longest, one-third again as broad as long. From the sixth segment onward a double dorsal spine is developed which on the fifteenth (to seventeenth) becomes a single spine which in height is equal to one-fourth the width of the segment. The paired prominences are distinct, though close together, being indistinct only on the sixth–ninth segments on which they almost form a transverse ridge. The antepenultimate and the segments immediately preceding have smaller spines. The height of the opposing spine is half the width of the penultimate segment. The terminal claw is about as long as the penultimate segment, and is stout and somewhat curved. The radials are visible as narrow bands beyond the rim of the centrodorsal. The IBr_1 are four times as broad as long (0.8 mm. in width) and are free laterally. The IBr_2 (axillaries) are half again as broad as long. The IIBr series are 2. The $IIBr_1$ is from half again to twice as broad as long, and is shorter on the inner than on the outer side. The ossicles immediately following the axillaries are united interiorly. Slight synarthrial tubercles are developed. The 19 smooth arms are 50 mm. long. After the seventh the brachials become wedge-shaped and distally triangular with swollen articulations. There are 18 brachials for each 10 mm., or 16 if the syzygial pairs are counted as units. Syzygies occur between brachials 3+4, 15+16 (or 18+19), and distally at intervals of from 7 to 10 (usually 9 or 10) muscular articulations. P_1 is 4 mm. long with 12 segments; it is occasionally absent on the inner arm from a IIBr axillary. P_2 is 7 mm. long with 14 segments of which the distal have spiny collars. P_a is most often absent. P_b is 5.5 mm. long with 12 segments. P_c is shorter than P_b. P_2 and P_b are very much stouter than the other pinnules; their longest segments are twice as long as broad, and are somewhat angular and spiny. The segments of the other pinnules are smooth. The distal pinnules are from 4.5 to 6 mm. long with 14–17 segments. The disk has been thrown off. The color is yellow with black-red spots.

One of the specimens from eastern Asia has 12 arms 45 mm. long. The other also has 12 arms; the processes on the distal ends of the segments of P_2 and P_3 are very strongly marked, suggesting certain forms of *Oligometra serripinna*.

The specimen without locality in the Copenhagen Museum is small with 12 arms.

The specimen from Okinawashima is small with 20 arms.

In one of the specimens from Bock's station 53, as described by Gislén, the cirri are XIV, 9, 2 mm. long. The third and fourth segments are twice as long as broad. There are no dorsal spines, but the ends of the segments are somewhat swollen. The height of the opposing spine is equal to half the width of the penultimate segment. The terminal claw is a little longer than the penultimate segment. The radials are twice as broad as long. The IBr_1 are as long as broad. The IBr_2 (axillaries) are half again as broad as long, and form a slight synarthrial tubercle with the IBr_1. The 10 arms are 13 mm. long. P_1 is 1.5 mm. long with 10+ segments. P_2 to P_5 are wanting. The disk is 1.3 mm. in diameter and is not incised. Gislén says that this is a young specimen, like the following.

In the other specimen from Bock's station 53 the cirri are XVI, 9–11, and are arranged in a single or partly double row. The 13 arms are 15+ mm. long. The IIBr series are 2. The brachials are very much hour-glass shaped. The intersyzygial interval is 4 or 5 muscular articulations. P_1 is 3.5 mm. long with 14 segments. P_2 is 2.5 mm. long with 13 segments. The disk is incised, and is dark red.

In one of the specimens from Bock's station 59, as described by Gislén, the centrodorsal is discoidal, 4.5 mm. in diameter and 1.8 mm. high, with the bare dorsal pole 3 mm. in diameter. The cirri are XXIX, 31–35, from 19 to 21 mm. long. The third and fourth segments are about as long as broad, the fifth-ninth are slightly longer than broad, and those succeeding are shorter again. The tenth-twelfth segments have a dorsal transverse ridge, the thirteenth-sixteenth have a 3-pointed prominence, and the sixteenth-twenty-fourth have at first a double and later a single dorsal spine. The two parts of the double prominences are sometimes not distinctly separated. The dorsal spines are very small but are well defined in side view; they are median in position, and in height equal one-fifth the width of the segments. The opposing spine is considerably larger than the spines on the segments preceding, in height equaling from one-half to two-thirds the width of the penultimate segment. The terminal claw is pointed, curved, and about as long as the penultimate segment. The radials project beyond the margin of the centrodorsal. The IBr_1 are six times as broad as long and are laterally free. The IBr_2 (axillaries) are twice as broad as long, their lateral sides making a slight angle with those of the IBr_1. There is a well-developed synarthrial tubercle on the articulation between the ossicles of the IBr series. The IIBr and IIIBr series are 2, the latter externally developed. The arms are 26 in number (probably originally 28), and are broken. They are smooth, and the brachials beyond the ninth are oblique. Syzygies occur between brachials 3+4, 18+19, and distally at an interval of (6–) 9 muscular articulations. P_1 is 6 mm. long with 17 segments; on the second brachial from the inner arm of a IIBr series P_1 is 6 mm. long with 14 segments. P_2 is 9.5 mm. long with 17 or 18 segments. P_3 is 7–8 mm. long with 16–18 segments. The distal segments of P_2 and P_3 are very long, three times as long as broad, and their distal ends are serrate. P_a is lacking. P_b resembles P_2. P_1 is usually absent on the inner arm of a IIIBr series. The distal pinnules are 7 mm. long with about 20 segments. The disk is very deeply incised, with the smallest diameter 4 mm. and the largest 10 mm. The color is red-violet with yellow longitudinal bands, distally with yellow and red spots mingled.

In another specimen from Bock's station 59 the bare dorsal pole of the centrodorsal is 2 mm. in diameter. The cirri are XXV, 25–31, from 15 to 20 mm. long. Usually a single dorsal spine is developed from the sixteenth segment onward. The middle prominence is larger on the proximal segments. The radials project beyond the rim of the centrodorsal in the interradial angles of the calyx. The IBr_1 are four times as broad as long. The division series are of rather uniform thickness. The IIBr and IIIBr series are 2. There are 16 arms—possibly 2 more—all broken. P_1 is from 5.5 to 6 mm. long with 14–16 segments, and is absent from the inner arms arising from IIIBr axillaries. All the brachials beyond the third are broken. The disk has been thrown off. The color is light brown.

Of the specimens from *Albatross* station 5213 the largest have the arms 95 mm. long. Ten have 11 arms, eight have 12 arms, six have 13 arms, four have 14 arms, three have 15 arms, two have 16 arms, three have 17 arms, two have 19 arms, and four have 20 arms. One is badly broken, and there are two 10-armed young.

The specimens from *Albatross* station 5212 have 16, 18, and 20 arms.

The six specimens and one fragment secured by the *Challenger* on the reefs at Cebu were regarded by Dr. P. H. Carpenter as representing a new species which he called *Antedon disciformis* and described as follows. The centrodorsal is a thick pentagonal disk with an irregular row of marginal cirri and the dorsal surface free. The cirri are XV–XX, 25–30. Several of the segments are longer than broad. The fourth or fifth segments project beyond their successors on the dorsal side, and those following gradually develop a sharp forward-projecting spine at their distal edge. As the segments shorten distally this comes to be placed farther and farther back, and is both shorter and more upright. The radials are mostly concealed. The IBr_1 are oblong, and are quite free laterally. The IBr_2 (axillaries) are pentagonal, nearly twice as long as the IBr_1. The postradial series are well separated and may divide twice. The IIBr series are 2. The $IIBr_1$ are nearly oblong. The 15–20 arms are probably about 75 mm. long and consist of about 120 smooth and rounded brachials of which the first few are discoidal and their successors triangular, about as broad as long, gradually becoming more quadrate. The first syzygy is between brachials 3+4, the second is from between brachials 9+10 to between brachials 15+16, and the distal intersyzygial interval is from 2 to 6 muscular articulations. P_1 is composed of about 18 short segments which are but little longer than broad. P_a is absent. The pinnules of the next pair (P_2 and P_b) are rather stouter and much longer than P_1, reaching 12 mm. in length and consisting of 20 elongated segments the apposed edges of which are somewhat produced toward the ventral side. P_3 may be nearly equal in size to P_2 or it may be distinctly smaller, and its successors diminish in length to about P_5, and then increase, becoming exceedingly slender in the outer parts of the arms. The disk is about 8 mm. in diameter and is naked and rather incised, with a few sacculi, which are very abundant along the ambulacra of the arms and pinnules. As preserved in alcohol the skeleton is almost white, with the perisome gray or brownish.

I examined four of these specimens at the British Museum in 1910. The longest cirrus segments are nearly twice as long as broad, and the dorsal spines on the outer cirrus segments are long and sharp. In 1925 Dr. Torsten Gislén also examined these specimens. He remarked that the disk is large, bulging out between the arms, and strongly incised between the primary arms. These specimens are considerably smaller than the specimen of the same species he described in 1922.

Carpenter said that *disciformis*, while resembling *manca* in its spiny cirri and in the absence of P_a, differs from it altogether in having no IIIBr axillary, and in the constant presence of P_1. Carpenter remarked that, the division series being quite free laterally, it stands rather near to *Antedon marginata* (=*Stephenometra protectus*), resembling it also in the elongated joints, in the great size of P_2 and P_b, and in the absence of a IIIBr axillary, though sharply distinguished from it by the absence of P_a and by the very spiny cirri. Carpenter noted that the extreme flatness of the centrodorsal and the limitation of the cirri to its margin so as to leave the dorsal surface free recall the characters of the Comasteridae, but the high articular faces of the radials, which are much wider below than above, are those of a typical endocyclic form. The lower parts of the fossae lodging the great ventral muscles are cut off from their upper portions, and the same peculiarity appears both on the proximal faces of the IBr_1 and on the distal faces of the axillaries. The ventral surface of the centrodorsal is marked by five minute radial pits corresponding to the ventral ends of the radial axial canals which are seen on the under (dorsal) surface of the radial pentagon. (See Part 2, p. 37.)

The three specimens from *Albatross* station 5356 are all small. One has 23 arms 45 mm. long, and is entirely deep purple in color. Another has 15 arms about 40 mm. long. The third has 10 arms 40 mm. long and the cirri 12 mm. long with 26–28 segments.

One of the specimens from Amboina Bay has 14 arms 60 mm. long. The cirri are XV, 22–25, 22 mm. long. The color in alcohol is light purplish gray with numerous red-brown dots on the dorsal surface. In color this individual closely resembles the large specimen of *Colobometra discolor* from Jolo, but the cirri are not banded.

The other specimen from Amboina Bay has 14 arms which were probably about 80 mm. long. The cirri are XVII, 25–27, 15 mm. long. The color in alcohol is dark purplish brown, the division series and arm bases with a narrow median whitish line. The arms beyond the bases are narrowly banded brown and whitish. The pinnules are purplish brown. The cirri are light purplish yellow.

Of the two specimens from the Danish Expedition to the Kei Islands station 54 one has 10 arms 45 mm. long and the other has 11 arms 60 mm. long.

The seven specimens collected by the Danish Expedition to the Kei Islands off Kombit, Banda, have 17, 14, 14, 14, 12, 11, and 10 arms.

The specimen from *Challenger* station 192 was described by Dr. P. H. Carpenter as a new species under the name of *Antedon manca*. The centrodorsal is a thick disk with a flattened dorsal surface and marginal cirri. The cirri are about XX, 25–30. A few of the segments are longer than broad, and dorsal spines are developed from the eighth onward. The radials are concealed. The IBr_1 are oblong, and are quite free laterally. The IBr_2 (axillaries) are pentagonal. The IIBr and IIIBr series are 2, but the latter are developed only on the outer side of the IIBr axillaries so that there are normally 6 arms to each postradial series arranged in 2, 1, 1, 2 order. But one IIIBr series is undeveloped. The 29 arms are 60 mm. long and consist of about 100 smooth and rounded segments of which the first few are discoidal and those following triangular, about as long as broad, but becoming quadrate farther out. The first syzygy is between brachials 3+4, the second is about brachials 19+20 or 20+21, and the distal intersyzygial interval is 4–10 (usually 6 or 7) muscular articulations. P_a is absent. P_1 is always absent on the innermost of every two arms arising from a IIIBr axillary, and sometimes also on the arms which are borne directly on the IIBr axillaries. But it is sometimes present on these latter arms, and always on the two outermost arms of each postradial series, though varying in size, consisting of 12 or 15 segments most of which are longer than broad. P_2 and P_b are sometimes twice as long as P_1, reaching 12 mm. in length and consisting of about 18 elongated segments with spines at their distal ends. P_3 is not half the size of P_2 and P_b, and is smaller than P_1, while the pinnules of the next pair (P_4 and P_d) are the smallest on the arm, after which the length of the pinnules increases slowly. The disk is 8 mm. in diameter, very much incised, and quite naked. Sacculi are very abundant on the arms and pinnules. As preserved in alcohol the skeleton is reddish brown, the perisome rather darker.

I examined this specimen at the British Museum in 1910. The longest cirrus segments are scarcely longer than broad. The dorsal spines on the outer cirrus segments are not nearly so broad as those in the specimens described as *Antedon disciformis*, resembling rather those of the form described as *Cyllometra albopurpurea*. Dr. Gislén, who examined it in 1925, said that the arm bases are well separated, and that the intervals between the syzygies are long.

Carpenter said that this is a very singular species the general relations of which are with *Antedon marginata* (=*Stephanometra protectus*) and *A. aequipinna* (*Lamprometra palmata*); but it is distinguished from them both, and from all other species with the IIBr series 2, by the peculiar distribution of the pinnules. The arrangement of the arm divisions seems to be like that of *Pentacrinus* (=*Diplocrinus*) *maclearanus*, IIIBr axillaries being developed only on the two outermost of the four secondary arms on each postradial series, so that the grouping of the arms is 2, 1, 1, 2. One one postradial series, however, a IIIBr axillary is missing, so that the total number of arms is 29 and not 30 as it otherwise would be.

P_a is always absent, as is also the case in *Antedon* (*Cyllometra*) *disciformis* and in *Decametra informis*, and P_1 is also absent in some arms. It is undeveloped on the inner arm of every pair which arises from a IIIBr axillary, and it is occasionally also absent on the two inner arms of the postradial series which are borne directly on the IIBr axillaries; though it is sometimes present on these, and it is always to be found on the two outermost arms of a postradial series. Of the two single arms which are borne on the inner faces of the two IIBr axillaries, one may have P_2 while it may be absent from the other, and there appears to be no constancy as to its occurrence in this position. When present it is somewhat smaller than the corresponding pinnule on the outside of the postradial series. The large P_2 and P_b are tolerably equal on all the arms, P_2 being perhaps a little the longer. But P_3 is much smaller again, and the pinnules of the next pair (P_4 and P_d) still more so, barely reaching 4 mm. The disk has a large pentagonal peristome but is much incised, and the anal tube appears to be quite at its margin, so far as one can judge from the mutiliated condition of the specimen. The sacculi do not appear to occur on the disk, but they are well developed on the arms, and especially so on the pinnule ambulacra.

In the specimen from *Siboga* station 305 the dorsal pole of the centrodorsal is flat, 2 mm. in diameter. The cirri are XV, 31, about 15 mm. long. The fifth-seventh segments are about as long as their distal width. The sixth and following segments have prominent paired dorsal spines which at first are widely separated but distally approach each other and merge into a single spine on the last two segments before the penultimate. The 19 arms are 60 mm. long, and are arranged on the five postradial series as follows: 4(1+3), 4(1+3), 3(1+2), 6(2, 1, 1, 2), 2. The IIIBr series are all externally developed. P_2 is 11 mm. long and is composed of 16 segments.

Of the two specimens from ?Kurrachi one has 16 and the other 18 arms.

The specimen from *Investigator* station 291 was described by the author as a new species under the name of *Cyllometra soluta.* The centrodorsal is thin discoidal with the bare polar area 2 mm. in diameter and the cirri arranged in a single marginal row. The cirri are XVI, 21–28, from 11 to 13 mm. long. The fourth or fifth and following segments are subequal, about as long as broad. The third or fourth and following segments have produced distal ends which soon transform into prominent paired dorsal spines, becoming single median dorsal spines on the terminal five or six. The structure of the division series and arms resembles that in *C. manca* and *C. albopurpurea.* The 14–18 arms are 55 mm. long. P_a is absent. P_1 is small and very slender, 3 mm. long with about 12 segments. P_2 is the largest and the longest pinnule on the arm, 11 mm. long with 17 segments of which the first is not so long as broad, the third is twice as long as broad, and the remainder are about three times as long as broad. The pinnule is much more slender than the corresponding pinnule in related forms, and is nearly smooth, the distal edges of the segments in the terminal portion projecting only very slightly. P_3 is 7 mm. long, similar to P_2 but very slender, the segments distally proportionately somewhat longer. The pinnules following are more slender still, about 5 mm. long with 15 segments, and flexible, gradually decreasing in length to 4 mm. and increasing again to 8 mm. distally. The color in alcohol is flesh color, with a few narrow bands dorsally and large blotches ventrally of purple.

Abnormal specimens.—In the specimen from off Hondo, Japan, described as *Cyllometra anomala* one of the seven IIBr series is 2 and the other six consist of 4 ossicles each united in two synarthrial pairs, the second ossicle in each case bearing a pinnule. There are also present three IIIBr series of two ossicles each, of which the second is not an axillary (see p. 145).

In a specimen with 21 arms from lat. 35° 11′ N., long. 138° 43′ E., the first syzygial pair is repeated, so that there are syzygies between brachials 3+4 and 5+6; the epizygals of both of these syzygial pairs are without pinnules.

In a specimen from Mortensen's station 10 one of the IIBr series is composed of 3 ossicles, all united by synarthry.

In another specimen from Mortensen's station 10 one of the IIBr series is 4(3+4), with a pinnule on the second element.

In a third specimen from Mortensen's station 10 the third brachial on the left branch from the right posterior postradial series bears externally a normal arm and internally a rudimentary arm with syzygies between brachials 1+2 and 16+17. In describing this specimen in his report upon Dr. Mortensen's collection, Dr. Gislén said that P_a had developed into a new arm; but in the diagram published in 1924 the new arm is shown to arise from the division of the fourth brachial, normally the epizygal of the first syzygial pair, into two ossicles.

In a fourth specimen from Mortensen's station 10 one postradial series bears to the right an undivided arm and to the left an arm which branches on the eighth brachial; on the outer branch the first syzygy is between brachials 6+7, and on the inner branch there are syzygies between brachials 1+2, 6+7, and 11+12.

Remarks.—Dr. P. H. Carpenter in 1888 described *Antedon manca* and *A. disciformis.* In his key to the species in the *Palmata* group he differentiated these species from the others in the group by the absence of P_a. He gave *manca* as having two axillaries following the IBr series and the inner arms of each postradial series usually without P_1, whereas *disciformis* has but one axillary following the IBr series, and P_1 is present on all the arms. These supposed differences have since proved to be of no significance.

In 1910 I examined the types of *manca* and of *disciformis* at the British Museum in London and found that in *manca* the longest cirrus segments are scarcely longer than broad and the dorsal spines on the outer segments are not nearly so long as in *disciformis*, in which the longest cirrus segments are nearly twice as long as broad, and the dorsal spines on the outer segments are long and sharp.

In 1918 I reviewed the relationships of *disciformis* and *manca* on the basis of a detailed examination of 56 specimens referred to *disciformis* from *Albatross* stations 5212, 5213, 5154, 5356, 5367, and 5369, and from the *Challenger* collection. I wrote that the cirri of typical *disciformis* and typical *manca* are very different. In both the dorsal spines are well developed, but in *disciformis* they are much longer than they are in *manca*, while furthermore the earlier cirrus segments in *disciformis* are elongated, twice as long as broad instead of only very slightly, if at all, longer than broad as in *manca*. However, I found that in deep and cold water the elongated earlier cirrus segments of *disciformis* as a rule rapidly shorten, so that the character of the cirri approaches that of typical *manca*.

In the key to the species of the genus *Cyllometra* published in 1918 I separated *disciformis* from *manca* on the basis of the relative length of the earlier cirrus segments, saying that in *disciformis* these are longer than broad and may be twice as long as broad or even longer, whereas in *manca* they are not longer than the width of their distal ends.

The differences between the cirri of *disciformis* and those of *manca* are by no means so considerable as this would appear to indicate. In the entire absence of correlated characters in other structures they are certainly not sufficient to justify maintaining *disciformis* and *manca* as distinct species. At the most *disciformis* may possibly deserve recognition as a form of *manca* inhabiting shallow and warm water.

In 1907 I mentioned indefinitely, under the name *Antedon manca*, specimens of a species of *Cyllometra* from Japan, and in April 1908 Dr. Hubert Lyman Clark definitely recorded *Cyllometra manca* from the Uraga Channel. On May 14, 1908, I described *Cyllometra albopurpurea*, which I said represents *C. manca* in the waters about southern Japan, differing strikingly from that species in having all the cirrus segments subequal in length, the distal with only slight paired tubercles on the dorsal side. I remarked further than in *C. manca* the proximal cirrus segments are much elongated, the distal short, with long bidentate or tridentate dorsal spines. The number of arms in *C. albopurpurea* varies from 10 to 30, but is most commonly about 20.

The form referred to in these remarks is not *manca* but *disciformis*, as is evident from the mention of the elongated earlier cirrus segments and the long dorsal spines.

In my key to the species of the genus *Cyllometra* published in 1918 I gave *albopurpurea* as having the cirrus segments subequal, mostly about as long as broad, the outer with minute dorsal tubercles, whereas in *manca* the outer cirrus segments are broader than long and bear small, though prominent, dorsal spines. In view of the great variability seen in specimens from Japan there can be little doubt that these supposed differences are illusory, and that in reality *albopurpurea* is a synonym of *manca.*

Cyllometra anomala, which I described in 1908, is merely an aberrant individual from southern Japan.

On June 25, 1909, I described *Cyllometra soluta* from specimens from the Straits of Ormuz at the entrance to the Persian Gulf. In the original description the only tangible difference between *soluta* and previously described forms is that in *soluta* P_2 is much more slender, and is nearly smooth. In the key to the species of *Cyllometra* published in 1918 *manca* is said to have 19–29 arms, IIIBr series, and the outer edges of the segments of P_2 with prominent spines at the prismatic angles, whereas *soluta* has 14–18 arms, no IIIBr series, and the outer edges of the segments of P_2 with small spines at the prismatic angles. These supposed differences are of little, if any, significance, and undoubtedly *soluta* should be suppressed as a synonym of *manca.*

Dr. Torsten Gislén in 1922 described *Cyllometra pulchella* from the vicinity of the Goto Islands, southwestern Japan. I can find nothing in his description to indicate any tangible difference between this supposed new species and *manca* as represented in the same region.

The forms described as *Antedon manca, A. disciformis, Cyllometra albopurpurea, C. anomala, C. soluta,* and *C. pulchella* seem to me undoubtedly to represent the same specific type. It is possible, however, that in the future some of these names may be found useful for designating more or less marked varietal forms or geographical races.

Dr. Torsten Gislén made a very careful study of the various forms assigned to the genus *Cyllometra* on the basis of a large number of specimens from southern Japan and the Bonin Islands collected by Dr. Sixten Bock and Dr. Theodor Mortensen.

In his report upon the crinoids collected by Dr. Bock he said that although *Cyllometra disciformis* is evidently very closely related to *C. manca* he nevertheless maintained them as separate species. He recalled that the author [in the *Siboga* report published in 1918] differentiated *disciformis* from *manca* on the basis of its elongated proximal cirrus segments, though stating at the same time that in *disciformis* the length of the cirrus segments rapidly decreases with increasing depth of water. He said that the deepest localities from which *disciformis* had previously been dredged are at 180 fathoms (329 meters). The specimens he recorded and described (from Bock's stations 12, ?33, and 35) were found at depths of 400 fathoms (731 meters) and 90 fathoms (164 meters) to 200 fathoms (366 meters), and these have very short cirrus segments approaching those of *manca.*

Dr. Gislén described as *manca* a specimen from Kiu Shiu (Bock's station 19) in which the cirrus segments are never longer than broad; it is smaller than the specimens of *disciformis* from shallower water, but in spite of that has shorter cirrus segments. He remarked that the larger *disciformis* seems also to have fewer arms in proportion to the length of the arms. He suggested that a differential character of value might be found in the distribution of the syzygies. In *disciformis*, according to him, the syzygies are separated by 3 or 4 muscular articulations, whereas in *manca* they are separated by 9 or 10. He noted that this difference is also to be found in the original descriptions, in which *disciformis* is said to have an intersyzygial interval of 2–6 brachials, that of *manca* being 4–10 (usually 7 or 8) brachials. He said that *disciformis* seems to be more slender than *manca* and to have longer and narrower distal pinnules.

Gislén remarked that the cirri in a specimen from Bock's station 59 identified by him as *Cyllometra albopurpurea* somewhat resembled those of *C. manca*, raising some doubt as to whether the two species are distinguishable. He said that this specimen corresponds in all other characters with another, which is a younger individual of the same type, but has pronounced *albopurpurea* cirri. Nevertheless, he said, certain differences may be given that speak in favor of *albopurpurea* as a species. In the specimen that he recorded and described as *C. manca* (from Bock's station 19) there are 25 cirrus segments in a cirrus 11 mm. long, and the segments are broader than long. He said that *albopurpurea* does not have the same number of cirrus segments until the cirri reach a length of 15 mm., and the proximal cirrus segments are longer than broad. He remarked that both the species during their evolution show a tendency toward short cirrus segments, but reach this stage at different cirrus lengths. He said that the characteristic dorsal spine of *C. albopurpurea* (and *C. gracilis*) is, in a somewhat similar form, to be found in the specimen from Bock's station 19 recorded as *C. manca*, though elsewhere referred to by him with some doubt as *C. disciformis*. Speaking of the young stages he said that young individuals of *albopurpurea* have more than 10 arms at an arm length of about 15 mm. when the brachials are still very juvenile, long, and strongly hourglass-shaped. The young of *disciformis* even at an arm length of 25 mm. have 10 arms and rather smooth brachials.

Regarding his new species, *Cyllometra pulchella*, Gislén said that it most nearly approaches *C. manca* from which it differs in having a smaller and less discoidal centrodorsal, longer cirrus segments which have only inconspicuous carinations, in the absence of IIIBr series, in the short intersyzygial interval, and in P_2 being almost smooth. He said that the small transverse carination on the proximal cirrus segments, which on some segments is replaced by a pair of microscopic tubercles, proves that *pulchella* is an oligophreate form, though otherwise it presents much that reminds us of certain species of Perometrinae—for instance, the relatively large size of the central cavity of the centrodorsal and the position of the rosette, which only radially forms "spoutlike" processes.

He remarked that in *C. pulchella* it is not always the largest specimens that have the most arms, but rather the reverse. He said it is probable that the question of catching the food plays a certain role; but possibly one might also connect the phenomenon with the fact that the family Colobometridae tends strongly toward a 10-armed type, and that this is reached only through a transition stage with more than 10 arms. However, he considered this not very likely, as he had often seen "duplicative" regenerates situated on the second brachial, but never a single arm regenerating from this ossicle.

In his description of the specimens identified as *albopurpurea* in Mortensen's collection Dr. Gislén said that the young can be distinguished from specimens of *pulchella* by the less numerous cirri and by the slender arms composed of long and very juvenile segments. The IBr series are also extremely long, and P_1 and P_2 have an equal number of segments.

A specimen from Mortensen's station 14 Gislén referred to *C. manca* because of its short and numerous cirrus segments, combined with the short cirri, and because of the long intersyzygial interval, although the dorsal spines on the cirri are tolerably small. Specimens from station 9, with their short-segmented and strongly rolled up cirri arranged in a single row on the centrodorsal he said may be regarded as the young of *manca*. He remarked that evidently the dorsal spines are not very reliable as specific characters.

To sum up, Dr. Gislén maintained the separation of *disciformis* and *manca* on the basis of the longer cirrus segments of the former, adding that the arms of *disciformis* seem to be fewer in proportion to their length, the distal intersyzygial interval is much shorter, the habitus is more slender, and the distal pinnules are longer and more slender. One specimen he formally recorded as *manca*, but elsewhere mentioned, with some doubt, as *disciformis*. The differences given by Gislén are all within the range of individual variation, or the variation resulting from differing degrees of maturity, or the variation resulting from the response to the immediate environment. He differentiated *pulchella* from *manca* by the smaller and less discoidal centrodorsal, the longer cirrus segments with only inconspicuous carinations, the absence of IIIBr series, the short intersyzygial interval, and the smooth P_2. These differences are in the direction of *disciformis* on the one hand, and *albopurpurea* on the other, and merely indicate a more or less stable varietal form corresponding to *disciformis* though differing from it in the lesser development of dorsal processes on the cirrus segments. A specimen identified by him as *albopurpurea* had cirri resembling somewhat those of *manca*, raising some doubt in his mind as to whether these two supposed species are really distinguishable. One specimen recorded as *manca* he said had, in a somewhat similar form, the characteristic dorsal spine of *albopurpurea*. But elsewhere he referred to this same specimen as *disciformis*. In another place he said that evidently the dorsal spines are not very reliable as specific characters. The differences he gives in the cirri and arms of *albopurpurea* and *manca* are merely individual, or are differences in the relative degree of maturity of the individuals compared.

Dr. Gislén's study of these forms leads one to the conclusion that while the names *manca*, *disciformis*, *albopurpurea*, and *pulchella* may be found useful in designating more or less stable forms or varieties within a single specific type, they certainly can not be regarded as covering distinct species.

Localities.—Golden Hind; Tokyo Bay, Japan; 15–22 meters; Alan Owston, October 22, 1899 [A. H. Clark, 1908] (23, U. S. N. M., 35290; 35346 [original No. 5586]; 35374 [original No. 5586]; 35393 [original No. 5586]; 35396 [original No. 5586]).

Golden Hind; Tokyo Bay; 24 meters; Alan Owston, October 22, 1899 (2, M. C. Z., 274).

Golden Hind; Uraga Channel, entrance to Tokyo Bay; 36–55 meters; Alan Owston, April 21, 1901 [A. H. Clark, 1908; H. L. Clark, 1908] (2, U. S. N. M., 35349 [original No. 5780]; M. C. Z., 338 [original No. 5776]).

Golden Hind; Uraga Channel; 46 meters; Alan Owston, May 26, 1901 [A. H. Clark, 1908] (1, U. S. N. M., 35386 [original No. 6067]).

Golden Hind; Uraga Channel; 55 meters; Alan Owston, May 17, 1901 (1, U. S. N. M., 35397 [original No. 6052]).

Golden Hind; Uraga Channel; 146 meters; Alan Owston, June 8, 1900 [A. H. Clark, 1908] (2, U. S. N. M., 35401 [original No. 6357]).

Uraga Channel; 150 meters; Prof. F. Doflein, October 23, 1904 (3, Munich Mus. [original No. 292 (part)]).

Entrance to Uraga Channel; 135 meters; Prof. F. Doflein, October 29, 1904 (1, Munich Mus. [original No. 287]).

Albatross station 5094; Uraga Channel; Joga Shima light bearing N. 18.5° W., 3.7 miles distant (lat. 35° 04′ 42″ N., long. 139° 38′ 20″ E.); 161 meters; bottom temperature 12.67° C., black sand and broken shells; October 26, 1906 (1).

Albatross station 5095; Uraga Channel; Joga Shima light bearing N. 28° W., 3 miles distant (lat. 35°05′34″ N., long. 139°38′36 ′ E.); 106 meters; bottom temperature 14.33° C.; fine black sand and broken shells; October 26, 1906 [A. H. Clark, 1908] (6, U. S. N. M., 35352; M. C. Z., 343, 357).

Albatross station 5071; Suruga Gulf; Ose Saki bearing S. 53.5° W., 2.6 miles distant (lat. 35°03′10″ N., long. 138°49′50″ E.); 104 meters; bottom temperature 21.56° C.; October 15, 1906 (1, U. S. N. M., 35284).

Albatross station 3701; Sagami Bay; Seno Umi bearing N. 10° W., 2.3 miles distant; 75–133 meters; May 7, 1900 (1, U. S. N. M., 35278).

Albatross station 3707; Sagami Bay; Ose Zaki bearing S. 53° W., 2.25 miles distant; 115–137 meters; volcanic sand, ashes, and gravel; May 8, 1900 (59, U. S. N. M. 35359, 35372; M. C. Z., 52, 273).

Albatross station 3708; Sagami Bay; Ose Zaki bearing S. 55° W., 2.25 miles distant; 110–128 meters; green mud, volcanic sand, and ashes; May 8, 1900 (2, U. S. N. M., 35399).

Albatross station 3713; Sagami Bay; Ose Zaki bearing S. 81° W., 4.2 miles distant; 82–88 meters; volcanic sand, shells, and rock; May 11, 1900 (1, U. S. N. M., 35296).

Albatross station 3715; Sagami Bay; Ose Zaki bearing S. 56° W., 1.6 miles distant; 119–124 meters; volcanic sand, shells, and rock; May 11, 1900 (2, U. S. N. M., 35288).

Albatross station 3716; Sagami Bay; Ose Zaki bearing S. 36° W., 0.8 mile distant; 119–228 meters; volcanic sand, shells, and rock; May 11, 1900 (7, U. S. N. M., 35295).

Albatross station 3717; Sagami Bay; Ose Zaki bearing S. 34° E., 0.8 mile distant; 115–183 meters; volcanic sand, shells, and rock; May 11, 1900 (1, U. S. N. M., 35391).

Albatross station 3720; Sagami Bay; Ose Zaki bearing S. 36° W., 0.8 mile distant; 115 meters; volcanic sand and shells; May 11, 1900 (14, U. S. N. M., 35355).

Albatross station 3725; Sagami Bay; Noma Saki bearing N. 18° E., 8.8 miles distant; 25 meters; sand, shells, and gravel; May 15, 1900 (1).

Albatross station 3726; Sagami Bay; Takamatsu Zaki bearing N. 5° W., 5.7 miles distant; 47 meters; gray volcanic sand; May 15, 1900 (4, M. C. Z., 276).

Albatross station 3727; Sagami Bay; Omai Zaki bearing N. 17° E., 9.7 miles distant; 62 meters; mud, coarse black sand, and shells; May 16, 1900 (5, U. S. N. M., 35345).

Albatross station 3729; Sagami Bay; Omai Zaki bearing N. 17° E., 12.7 miles distant; 62 meters; mud and gravel; May 16, 1900 (3, U. S. N. M., 35382).

Albatross station 3755; Sagami Bay; Suno Saki bearing S. 63° E., 3.6 miles distant; 95–140 meters; gray sand and coral; May 19, 1900 (2, U. S. N. M., 35375).

Albatross station 3764; Sagami Bay; Suno Saki bearing S. 64° E., 2.8 miles distant; 80–91 meters; May 22, 1900 (3, U. S. N. M., 35277).

Golden Hind; Sagami Bay (lat. 35°06′ N., long. 139°42′ E., 55 meters, April 24, 1902 [No. 7215]; or lat. 34°59′ N., long. 139°33′ E., 110 meters, April 20, 1902 [No. 7214]); [A. H. Clark, 1908] (2, U. S. N. M., 35380).

Golden Hind; Sagami Bay (lat. 35°02′ N., long. 138°50′ E.); 100 meters [A. H. Clark, 1908] (11, U. S. N. M., 35266 [original No. 7036]).

Golden Hind; Sagami Bay (lat. 34°58′ N., long. 138°45′ E.); 141 meters; Alan Owston, August 13, 1902 [A. H. Clark, 1908] (1, U. S. N. M., 35292 [original No. 9274]).

Golden Hind; Sagami Bay (lat. 35°11′ N., long. 139°45′ E.); 91 meters; Alan Owston, June 30, 1901 [A. H. Clark, 1908] (5, U. S. N. M., 35273 [original No. 6106]).

Golden Hind; Sagami Bay (lat. 35°13′ N., long. 139°45′ E.); 73 meters; Alan Owston, November 9, 1902 [A. H. Clark, 1908] (1, U. S. N. M., 35283 [original No. 7283]).

Golden Hind; Sagami Bay (lat. 35°13′ N., long. 139°45′ E.); 73 meters; Alan Owston, November 9, 1902 [A. H. Clark, 1908] (1, U. S. N. M., 35378 [original No. 7283]).

Golden Hind; Sagami Bay (lat. 35°11′ N., long. 138°43′ E.); 55 meters; Alan Owston, December 1, 1901 [A. H. Clark, 1908] (5, U. S. N. M., 35350 [original No. 6659]).

Golden Hind; Sagami Bay (lat. 34°59′ N., long. 139°34′ E.); 100 meters; Alan Owston, April 23, 1902 [A. H. Clark, 1908] (1, U. S. N. M., 35381 [original No. 6332]).

Near Misaki; 100 meters; Prof. Franz Doflein, October 28, 1904 (2, U. S. N. M., 36047 [original No. 433]; Munich Mus. [original No. 433]).

Dr. Sixten Bock's Expedition to Japan, 1914; station ?33; Okinose, Sagami Bay; 183–366 meters; June 26, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan, 1914; station 35; Okinose, Sagami Bay; 731 meters; June 28, 1914 [Gislén, 1922].

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; station 19; off Misaki, Sagami Bay; 146–219 meters; sand; June 10, 1914 [Gislén, 1927].

Ito; Doctor Haberer, January 8, 1903 (1, Munich Mus. [original No. 9311]).

Between Ito and Hatsushima, Sagami Bay; about 150 meters; Doctor Haberer, March 1903 (20, U. S. N. M., 35764, 35765; Munich Mus. [included in Nos. 4204, 4210, 4215, 4216, 4220, and 9300]).

Fukuura, Sagami Bay; about 150 meters; Doctor Haberer, March 1–12, 1903 (8, Munich Mus. [original No. 4140]).

Iagoshima, Sagami Bay; 150 meters; Prof. Franz Doflein, October 25, 1904 (3, Munich Mus. [original No. 324]).

Golden Hind; off Aburatsubo, Sagami Bay; 110 meters; Alan Owston, April 2, 1899 [A. H. Clark, 1908] (1, U. S. N. M., 35402 [original No. 5417]).

Golden Hind; off Sunosaki, Sagami Bay; 100 meters; Alan Owston, May 8, 1899 [A. H. Clark, 1908] (1, U. S. N. M., 35389 [original No. 5417]).

Golden Hind; off Yenoshima; 146–238 meters; Alan Owston (1, M. C. Z., 275).

Golden Hind; Misuka, Japan; Alan Owston (2, M. C. Z., 277).

Albatross; Sagami Bay; 1900 (1, U. S. N. M., 35360).

Golden Hind; Sagami Bay; Alan Owston (1, U. S. N. M., 35394).

Sagami Bay; Doctor Haberer, April 1904 (7, Munich Mus.).

Golden Hind; Japan; Alan Owston (6, M. C. Z., 53, 278).

Off Hondo (Nipon) [A. H. Clark, 1908, 1909] (1, C. M.).

Inland Sea, Japan [A. H. Clark, 1913] (3, B. M.).

Japan; Dr. Franz Martin Hilgendorf [A. H. Clark, 1912] (detached arms, Berl. M., 2829).

Albatross station 4948; Eastern Sea, between Kobe and Kagoshima; O Shima light bearing N. 11° E., 12 miles distant (lat. 31°19′00″ N., long. 131°23′00″ E.); 119 meters; bottom temperature 17.00° C.; dark gray volcanic sand, broken shells, and pebbles; August 21, 1906 (1, U. S. N. M., 35351).

Albatross station 4929; in Colnett (or Vincennes) Strait; northeastern point of Yaku Shima bearing N. 16° W., 10 miles distant (lat. 30°12′30″ N., long. 130°43′00″ E.); 153 meters; bottom temperature 23.78° C.; broken shells, coral, and pebbles; August 15, 1906 (2, U. S. N. M., 35286).

Albatross station 4936; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 21° E., 5.7 miles distant (lat. 30°54′40″ N., long. 130°37′30″ E.); 188 meters; bottom temperature 15.89° C.; stones; August 16, 1906 (2, U. S. N. M., 35388, 36051).

Albatross station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 58° E., 4.5 miles distant (lat. 30°57′20″ N., long. 130°35′10″ E.); 188 meters; bottom temperature 15.89° C.; stones; August 16, 1906 (6, U. S. N. M., 35379, 35383, 35392, 35398).

Albatross station 4934; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 77.5° E., 7 miles distant (lat. 30°58′30″ N., long. 130°32′00″ E.); 188–278 meters; bottom temperature 13.33° to 15.89° C.; bottom, rocky; August 16, 1906 (31+, U. S. N. M., 35285, 35358, 35403, 36233; M. C. Z., 339).

Albatross station 4884; Eastern Sea, about 20 miles southwest of Nagasaki entrance; Nomo Zaki bearing N. 76° E., 11.5 miles distant (lat. 32°32′00″ N., long. 129°30′45″ E.); 97 meters; bottom temperature 16.50 C.; dark gray sand and broken shells; August 8, 1906 (1, U. S. N. M., 35294).

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; station 14; Nagasaki; 1914 [Gislén, 1927].

Korean Strait (lat. 33°00′ N., long. 129°24′ E.); 40 meters; Captain Schönau [A. H. Clark, 1909] (1, C. M.). Same locality; 55 meters (2, C. M.).

Near Hirado Island (lat. 33°10′ N., long. 129°18′ E.); 73 meters; Captain Suensson [A. H. Clark, 1909] (12, C. M.).

Albatross station 4902; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 10° E., 6 miles distant (lat. 32°30′50″ N., long. 128°34′40″ E.); 254 meters; bottom temperature 11.61° C.; gray sand and broken shells; August 10, 1906 (5, U. S. N. M., 35390).

Albatross station 4903; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 22° E., 6 miles distant (lat. 32°31′10″ N., long. 128°33′20″ E.); 195–254 meters; bottom temperature 11.61° C.; gray sand and broken shells; August 10, 1906 (20, U. S. N. M., 35274, 35312).

Albatross station 4895; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 42° E., 4.7 miles distant (lat. 32°33′10″ N., long. 128°32′10″ E.); 174 meters; bottom temperature 13.28° C.; green sand, broken shells, and pebbles; August 9, 1906 (3, U. S. N. M., 35287, 35289, 35376).

Albatross station 4904; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 27° E., 6 miles distant (lat. 32°31′20″ N., long. 128°32′40″ E.); 195 meters; fine gray sand and broken shells; August 10, 1906 (3, U. S. N. M., 35377).

Albatross station 4894; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 41° E., 5 miles distant (lat. 32°33′00″ N., long. 128°32′10″ E.); 174 meters; bottom temperature 13.28° C.; green sand, broken shells, and pebbles: August 9, 1906 (1, U. S. N. M., 35293).

Korean Straits (lat. 33°05′ N., long. 128°22′ E.); 46 meters; Captain Schönau [A. H. Clark, 1909] (16, C. M.).

Near the Goto Islands (lat. 32°10′ N., long. 128°20′ E.); 183 meters; Captain Schönau [A. H. Clark, 1909] (1, C. M.).

Korean Straits (lat. 33°08′ N., long. 129°20′ E.); 66 meters; Captain Schönau [A. H. Clark, 1909] (1, C. M.).

Korean Straits (lat. 33°09′ N., long. 128°18′ E.); 183 meters; Captain Schönau [A. H. Clark, 1909] (1, C. M.).

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; station 9; off Kiu Shiu (lat. 35°15′ N., long. 128°12′ E.); 164 meters; hard bottom; May 15, 1914 [Gislén, 1927].

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; station 10; north of the Goto Islands (lat. 33°41′ N., long. 128°50′ E.); 137 meters; sand; May 17, 1914 [Gislén, 1927].

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; station 11; north of the Goto Islands (lat. 34°10′ N., long. 129°09′ E.); from the surface of the sea; May 17, 1914 [Gislén, 1927].

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; station 7; southwest of the Goto Islands (lat. 32°17′ N., long. 128°11′ E.); 201 meters; sand; May 14, 1914 [Gislén, 1927].

Near the Goto Islands (lat. 32°12′ N., long. 128°10′ E.); 183 meters; Captain Suensson [A. H. Clark, 1909] (5, C. M.).

Dr. Sixten Bock's Expedition to Japan, 1914; station 12; Goto Islands, coral bank; 164 meters; May 15, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan, 1914; station 13; off the Goto Islands (lat. 33°41′ N., long. 128°50′ E.); 137 meters; May 17, 1914 [Gislén, 1922] (2, U. S. N. M., E. 1113).

Dr. Sixten Bock's Expedition to Japan, 1914; station 16; off the Goto Islands (lat. 33°41′ N., long. 128°50′ E.); 137 meters; May 17, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan, 1914; station 17; off the Goto Islands (lat. 33°41′ N., long. 128°50′ E.); 137 meters; May 17, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan, 1914; station 6; Kagoshima and Okinoshima; 128, or 201–402 meters; May 13–14, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan, 1914; station 19; off Okinoshima, Kiu Shiu; 47 meters; bottom temperature 17° C.; May 18, 1914 [Gislén, 1922].

Eastern Asia; Captain Suensson (2, C. M.).

No locality (but undoubtedly in the Korean Straits); Captain Suensson [A. H. Clark, 1909] (1, C. M.).

Okinawashima, Riu Kiu (Liu Kiu) Islands; U. S. North Pacific Exploring Expedition [A. H. Clark, 1912, 1918] (1, Y.M.).

Dr. Sixten Bock's Expedition to Japan, 1914; station 53; Bonin Islands; Higashijima 2 miles east; 164 meters; sand and broken shells; August 7, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan, 1914; station 59; Bonin Islands; east northeast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922].

Albatross station 5369; near Marinduque Island; Taybas light (outer) bearing N. 50° W., 8.8 miles distant (lat. 13°48′00″ N., long. 121°43′00″ E.); 194 meters; black sand; February 24, 1909 [A. H. Clark, 1911, 1912, 1918] (1, U.S.N.M., 35949).

Albatross station 5367; Verde Island Passage; Malabrigo light bearing N. 81° E., 8 miles distant (lat. 13°34′37″ N., long. 121°07′30″ E.); 329 meters; sand; February 22, 1909 (1, U.S.N.M., 36224).

Albatross station 5213; east of Masbate Island; Destacado Island (S.) bearing N. 87° E., 8.5 miles distant (lat. 12°15′00″ N., long. 123°57′30″ E.); 146 meters; sand, mud, and shells; April 20, 1908 [A. H. Clark, 1908, 1912, 1918] (42+, U.S.N.M., 35314, 36037).

Albatross station 5212; east of Masbate Island; Panalangan Point bearing S. 54° 30′ E., 14.5 miles distant (lat. 12°04′15″ N., long. 124°04′36″ E.); 197 meters; gray sand and mud; April 20, 1908 [A. H. Clark, 1909, 1912, 1918] (3, U.S.N.M., 35348).

Challenger; Cebu reefs, Philippines [P. H. Carpenter, 1888; Hartlaub, 1891, 1895; A. H. Clark, 1907, 1912, 1913, 1918] (5, U.S.N.M., 17529; B.M.).

Albatross station 5355; North Balabac Strait; Balabac light bearing S. 61° W., 16.6 miles distant (lat. 8°08′10″ N., long. 117°19′15″ E.); 80 meters; coral and sand; January 5, 1909 (1, U.S.N.M., 35276).

Albatross station 5356; North Balabac Strait, between Palawan and Balabac Island; Balabac light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″ E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911, 1912, 1918] (3, U.S.N.M., 35275; 35280).

Albatross station 5154; Tawi Tawi group, Sulu (Jolo) Archipelago; Bakun Point light bearing S. 11° W., 0.7 mile distant (lat. 5°14′50″ N., long. 119°58′45″ E.); 22 meters; coral sand; February 19, 1908 [A. H. Clark, 1909, 1912, 1918] (1, U.S.N.M., 35270).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Ambonia Bay; about 50 meters; stones and sand; March 2, 1922 (2).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 54 (2).

Danish Expedition to the Kei Islands; off Kombit, Banda; about 70–90 meters; sand; June 6, 1922 (7).

Challenger station 192; near the Kei Islands (lat. 5°49′15″ S., long 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [von Graff, 1884; P. H. Carpenter, 1888; Hartlaub, 1891; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918] (1, B.M.).

Siboga station 305; mid-channel in Solor Strait, east of Flores; off Kampong Menanga; 113 meters; stony bottom; February 8, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Rotti Strait, from the Banjuwangi-Darwin No. 2 cable; 183 meters; cable repair ship *Cable*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (3, B.M.)

Investigator; ?Kurrachi [A. H. Clark, 1912] (2, U.S.N.M., 35353, 35357).

Investigator station 291; Straits of Ormuz, entrance to the Persian Gulf (lat. 26°22′00″ N., long. 56°10′00″ E.); 88-90 meters; mud; November 1, 1901 [A. H. Clark, 1909, 1912] (1, I.M.).

Doubtful locality.—*Albatross* station 4905; Eastern Sea, between 10 and 20 miles southwest of the Koshika Islands; Tsurikake Saki light bearing S. 85° E., 18.5 miles distant (lat. 31°39′00″ N., long. 129°19′00″ E.); 674 meters; bottom temperature 6.33° C.; August 11, 1906 (1 calyx).

The same net was used in this dredge haul that was used at the preceding station (4904), and it is probable that this small fragment was overlooked in cleaning the net after its use at that station on the preceding day

Geographical range.—Southern Japan from Tokyo Bay to the Korean Straits, the Bonin and Riu Kiu Islands, southward to the Philippine, Kei, and Lesser Sunda Islands, and westward to the Persian Gulf.

Bathymetrical range.—From 22 (?15) down to 329 (?731) meters. Most of the records are from depths between 90 and 200 meters. Young specimens have been taken swimming at the surface.

Thermal range.—From 11.61° to 23.78° C. The average of 14 records is 15.57° C.

History.—This species was first mentioned by Dr. P. H. Carpenter in 1881 as a species of *Antedon* dredged by the *Challenger* in which P_1 is present as usual but P_a is absent, though P_2 and the succeeding pinnules are perfectly normal.

Under the manuscript name of *Antedon manca* it was mentioned by Prof. Ludwig von Graff as a host for myzostomes in 1884.

In the *Challenger* report on the comatulids published in 1888 Carpenter described in detail and figured *Antedon manca* and *A. disciformis.*

In 1891 Dr. Clemens Hartlaub inserted *manca* and *disciformis* in his key to the species of the *Palmata* group, using the differential characters employed by Carpenter in his key in 1888. Hartlaub also compared both *manca* and *disciformis* with his new species *Antedon* (*Petasometra*) *clarae.* Hartlaub in 1895 mentioned certain features of the radial articular faces, as described and figured by Carpenter, in comparison with those of a new species, *Antedon* (*Florometra*) *tanneri.*

To my description of *Antedon* (*Neometra*) *multicolor* published in 1907 I appended a note on the colors of various species of comatulids, among them *Antedon manca.* My idea of *Antedon manca* was based upon a very large number of specimens which I had collected in the previous year while serving as acting naturalist on the *Albatross.* In parentheses after *Antedon manca* I included *A. disciformis* and *A. clarae* as synonyms. In a paper including diagnoses of new genera of comatulids published in 1907, under the genus *Heliometra,* I said that the extraordinary *Cyllometra manca* (accepted in the same sense as in the paper just cited) exhibits more individual than *Heliometra* does generic variation.

Dr. Hubert Lyman Clark in April 1908 recorded a specimen of *Cyllometra manca* from the Uraga Channel, Gulf of Tokyo, in 20–30 fathoms, that he had found in a lot of 153 specimens of echinoderms purchased by the Museum of Comparative Zoology from Alan Owston of Yokohama.

In a paper published on May 14, 1908, I briefly diagnosed *Cyllometra albopurpurea*, the type specimen being from *Albatross* station 5095. The diagnosis was in the form of a comparison with *C. manca* and *C.* (*Decametra*) *tigrina*. My conception of *C. manca* was based upon as yet unrecorded specimens at hand which had shortly before been collected by the *Albatross* at station 5213 in the Philippines. Because of their elongated proximal cirrus segments these specimens should have been referred to *C. disciformis*, if this form is to be recognized. In a paper published on July 15, 1908, I recorded 30 specimens of *Cyllometra albopurpurea* from 14 localities in Sagami Bay and Tokyo Gulf where they had been collected by Alan Owston in his yacht the *Golden Hind*. Mr. Owston's collection of crinoids had been purchased in 1907 by Frank Springer and deposited in the National Museum. In a paper published on December 10, 1908, I described *Cyllometra anomala* from a specimen in the Copenhagen Museum from southern Japan which proved to be simply an abnormal individual of the form described earlier in the same year as *Cyllometra albopurpurea*. In a preliminary notice of a collection of crinoids made by the *Albatross* in the Philippines published on December 23, 1908, I recorded *Cyllometra manca* from station 5213 without comment. If *disciformis* is to be considered as separate from *manca*, these specimens should be considered as representing *disciformis* and not *manca*. In a second preliminary paper on the crinoids collected by the *Albatross* in the Philippine Islands published on May 13, 1909, I recorded, without comment, *Cyllometra manca* from stations 5154 and 5212. These specimens should have been referred to *disciformis*. On June 25, 1909, I described *Cyllometra soluta* from specimens that had been collected by the Royal Indian Marine Surveying steamer *Investigator* in the Straits of Ormuz in 48–49 fathoms. In a paper on the crinoids of the Copenhagen Museum published later in 1909, I recorded and gave notes upon 38 specimens of *Cyllometra albopurpurea* that had been collected by Captains Suensson and Schönau at eight localities off southwestern Japan, and also listed *Cyllometra anomala*. In a third paper on crinoids collected by the *Albatross* in the Philippines, published on February 15, 1911, I recorded and gave notes on three specimens of *Cyllometra manca* from station 5356, and mentioned one from station 5369. As in the case of the Philippine specimens previously recorded these should have been referred to *disciformis*.

In April 1912, Dr. Clemens Hartlaub listed *Antedon manca*, *A. albopurpurea*, and *A. anomala* among the ten comatulids lacking P_a. He said that I had quite properly segregated these into a group for which I used the generic name *Cyllometra*. But he preferred to use Carpenter's systematic arrangement and therefore referred them to the genus *Antedon*.

In the description of *Cyllometra gracilis* published in July 1912, I compared it with *C. manca*. Here *manca* refers to the true *manca* and not to *disciformis* as in the papers on the crinoids collected by the *Albatross* in the Philippines.

In a paper on the crinoids in the Berlin Museum published on November 20, 1912, a specimen of *Cyllometra albopurpurea* collected by Dr. F. Hilgendorf in Japan was recorded.

In my memoir on the crinoids of the Indian Ocean published on November 22, 1912, I redescribed and figured *Cyllometra soluta* and listed *C. manca*, *C. albopurpurea*, *C. disciformis*, and *C. anomala*, giving their synonymy and ranges. In a paper on the crinoids of eastern Asia based upon a collection made by Captain Suensson published on August 8, 1913, I recorded *Cyllometra albopurpurea* from Okinawashima, Riu Kiu Islands. This record was based upon a specimen in the Yale University Museum, although that fact was not mentioned. In a paper on the crinoids of the British Museum published on December 31, 1913, I gave notes on the type specimens of Carpenter's *Antedon manca* and *A. disciformis*, and recorded three specimens of *Cyllometra albopurpurea* from the Inland Sea. My report on the crinoids of the *Siboga* expedition published in March 1918 included a key to the species of *Cyllometra* in which *disciformis*, *albopurpurea*, *manca*, and *soluta* were accepted as valid species. A specimen of *C. manca* from station 305 was recorded and described, and *C. disciformis* was discussed in detail on the basis of 56 specimens from the *Albatross* Philippine collection.

Dr. Torsten Gislén in 1922 recorded and gave detailed notes on three specimens of *Cyllometra disciformis* from Bock's stations 12, ?33, and 35; one specimen of *C. manca* from station 19; and four specimens of *C. albopurpurea* from stations 53 and 59. At the same time he described *C. pulchella* on the basis of 46 specimens from stations 6, 12, 13, 16, and 17. In 1924 Dr. Gislén discussed various morphological points in connection with this species.

In a memoir on the crinoids collected in Japan by Dr. Th. Mortensen, which was published in 1927, Dr. Gislén recorded and gave extensive notes on specimens identified as *Cyllometra pulchella*, *C. albopurpurea*, and *C. manca*.

In 1929 I recorded three specimens of *Cyllometra manca* from Rotti Strait where they had been found on the Banjuwangi-Darwin No. 2 cable by the cable repair ship *Cable* of the Eastern and Associated Telegraph Co.

CYLLOMETRA GRACILIS A. H. Clark

Plate 18, Figures 88–90; Plate 19, Figure 97

Cyllometra gracilis A. H. Clark, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 35 (description; *Siboga* station 49*a*); Unstalked crinoids of the *Siboga* Exped., 1918, p. viii (discovery by the *Siboga* and its significance), p. ix (relationship with *C. albopurpurea*), p. 114 (in key; range), p. 115 (detailed description; station 49*a*), p. 271 (listed), pl. 20, fig. 48.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 84 (comparisons).

Diagnostic features.—The cirri are relatively long and slender, 21 mm. long with 25–30 segments of which the longest are about twice as long as the proximal width; the 26–28 arms are about 50 mm. long.

Description.—The centrodorsal is discoidal with a flat or slightly concave dorsal pole 2 mm. in diameter. The cirrus sockets are arranged in one and a partial second marginal row.

The cirri are XXIII, 25–30, 21 mm. long. The first segment is very short, the second is about twice as long as the first, from one-third to one-half again as broad as long, the third is slightly longer than broad, the fourth is slightly longer than the third, the fifth is nearly as long as the sixth, and the sixth-ninth or -tenth are about twice as long as the proximal width. The segments following gradually decrease in length so that the last 12 before the penultimate are subequal, slightly longer than broad. The cirri as a whole are long and unusually slender. Owing to the crowded condition of the cirri on the centrodorsal the first segment of each cirrus is sharply flattened laterally against those of the cirri on either side. The distal dorsal edge of the fourth and following segments is slightly swollen, this swelling after the seventh segment becoming a trio of dorsal spines, a central larger and two lateral smaller, the central projecting dorsally more than the two lateral, but not extending so far distally. All three are very small. On the last twelve to fifteen segments before the penultimate the lateral spines disappear and the median becomes slightly more prominent, appearing as a single submedian tubercle which is directed obliquely forward. All the dorsal processes are small and inconspicuous.

The radials project very slightly beyond the rim of the centrodorsal in the midradial line, but extend well up in the interradial angles of the calyx where they entirely and widely separate the bases of the IBr_1; the division series resemble those of the other species of the genus. IIIBr series appear always to be present, at least on a minority of the postradial series, and are always external, the arms being arranged in 2, 1, 1, 2 order.

The arms in the larger individuals are 26–28 in number, and are about 50 mm. long.

Locality.—*Siboga* station 49*a*; Sapeh Strait, between Sumbava and Komodo (lat. 8°23′30″ S., long. 119°04′36″ E.); 69 meters; coral and shells; April 14, 1899 [A. H. Clark, 1912, 1918; Gislén, 1922] (14, U.S.N.M., E.433; Amsterdam Mus.).

History.—This species is as yet known only from the type series collected by the *Siboga*. It was described in 1912 and redescribed and figured in 1918.

Genus DECAMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 205, and following authors.

Cyllometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357.

Oligometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 308; Proc. Biol. Soc. Washington, vol. 22, 1909, p. 41.

Colobometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, pp. 5, 9, 30; Crinoids of the Indian Ocean, 1912, p. 168.

Decametra A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 13 (common to southeast Africa and Ceylon, but not occurring in the Arabian Sea), p. 31 (no diagnosis and no genotype given; 3 species described as new under this generic name, *D. möbiusi*, *D. modica*, and *D. alaudae; informis* and *taprobanes* also referred to this genus in comparisons with the new species); Mem. Australian Mus., vol. 4, 1911, pp. 730, 731 (in keys), p. 735 (one species in Australia), p. 774 (original reference; genotype designated as *D. möbiusi;* characters; range); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 25 (relation to *Petasometra*); Crinoids of the Indian Ocean, 1912, p. 11 (represented in the Ceylon region), p. 12 (represented in the Red Sea and southeast African region), p. 22 (distribution in detail), p. 58 (in key), p. 158 (original reference; genotype); Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery of 3 small species linking this genus with *Prometra* and *Oligometra*), p. 112 (in key), p. 117 (key to the included species).—Gislén, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, pp. 27, 30; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18; Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol.

17, No. 2, 1938, p. 4.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 52 (notes).

Prometra A. H. CLARK, Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 267 (*nomen nudum*), p. 269 (used in the combination *Prometra* [*Decametra*] *brevicirra, nomen nudum*); Ann. Mag. Nat. Hist., ser. 8, vol. 10, No. 55, 1912, pp. 37–29 (used without comment as a generic name in the description of *Prometra laevipinna*, *P. minima*, and *P. parva*); Crinoids of the Indian Ocean, 1912, p. 321 (diagnosis; genotype *Colobometra chadwicki* A. H. Clark, 1911; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery of intermediates between this genus and *Decametra*), p. 112 (in key, p. 125 (key to the included species).—GISLÉN, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 2; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Prometra (*Decametra*) A. H. CLARK, Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 269.

Colobometra (*Prometra*) (part) A. H. CLARK, Crinoids of the Indian Ocean, 1912, pp. 321, 322.

Amphimetra (part) A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179.

Diagnosis.—A genus of Colobometridae including small or medium-sized species with 10 arms in which P_1 is shorter, more slender, and more delicate than P_2 and is composed of shorter segments, which have smooth or spinous distal ends; P_a is absent; and the proximal cirrus segments bear dorsally a transverse ridge that distally becomes a pair of tubercles or small spines, or rarely a single median spine.

Geographical range.—Southern Japan from Sagami Bay to the Korean Straits, Hong Kong, southward to off the Clarence River, New South Wales, and Dirk Hartog Island, Western Australia, and westward to the eastern coast of Africa from Suez Bay south to Bagamoyo, Tanganyika Territory.

Bathymetrical range.—From the shore line down to 137 meters. Of the 16 species, 11 have been taken in shore collecting, and 5 are known only as littoral forms. The 6 species not as yet reported from the shore line have an upper limit of 9, 13, 18, 33, 55, and 64 meters. Nearly all the species are confined to shallow water; 7 are found between 36 and 40 meters; 6 are found between 41 and 45 meters; 5 are found between 46 and 55 meters; 4 occur between 56 and 70 meters; 3 are known from between 71 and 90 meters; and only a single one extends deeper than 90 meters, reaching a maximum depth of 137 meters, though occurring most frequently as a littoral and sublittoral form.

Remarks.—The genus *Decametra* as herein understood includes 16 species which, taken as a whole, show a remarkable uniformity of structure.

The cirri are IX to XXX, most commonly XIV–XX, in number, and are composed of 10–29, most frequently 18–23, segments, which are subequal or increase slightly in length distally, and are from twice as broad as long to about as long as broad, or terminally slightly longer than broad. The earlier segments bear dorsally a distal transverse ridge which soon moves to a median position and later usually, though not always, becomes resolved into a pair of small blunted or pointed tubercles; rarely the transverse ridge may persist as far as the antepenultimate segment, or it may become narrowed into a single median spine or tubercle some distance proximal to this. The cirri vary from 2.5 to 14 mm. in length, being usually from 10 to 13 mm. long.

The arms vary from 35 to 110 mm. in length, being usually between 35 and 70 mm. long. The species with the longest arms are not necessarily the largest, for in some forms the arms are, or may be, very slender and much elongated, while in others they are stout and rather short.

P_1 varies from very small and weak, not more than half as long as P_2, to nearly as long as the latter and almost as well developed. It is composed of from 8 to 21, usually 12–15, segments, and is from 2 to 8, usually 4–6, mm. long. P_2 is the longest and stoutest pinnule. It is composed of from 8 to 21 segments, the most common numbers being 11–13 and 15–18. It tapers gradually and evenly from the base to a delicate tip, is more or less recurved, and its segments become more or less elongated distally. It is from 3 to 13, most commonly 6–9, mm. long. P_3 varies from 1.5 to 8 mm. in length, being usually either about 3 or 6–7 mm. long. It is composed of 8–15, usually either about 8 or about 14, segments. It may closely resemble P_2, being only slightly smaller, or it may resemble P_4 and the pinnules following; but it is usually intermediate between P_2 and P_4.

The segments of the proximal pinnules beyond the basal become more or less elongated with usually more or less prominently spinous distal ends; they are rarely entirely smooth, or practically so.

On the basis of our present knowledge specific lines within the genus *Decametra* are difficult to draw, and the present interpretation of specific limits must be regarded as largely tentative.

Decametra intermedia is evidently based upon an immature individual, and is probably the young of one of the other species. In mature individuals of species of this genus P_1 is never longer than P_2.

Decametra zebra from the coast of New South Wales is rather sharply separated from the other species of the genus by the spinous carination of the basal segments of P_2.

Decametra chadwicki from the Gulf of Suez and *D. tigrina* from southern Japan form a well-marked group characterized by the possession of 18–26 cirrus segments, most of which are about as long as broad, by having the lower pinnules markedly stiffened and composed of segments with prominently spiny distal ends, and by having P_2 about as long as the cirri and composed of about 20 segments.

Decametra alaudae, *D. taprobanes*, and *D. arabica* agree in having a large number (23–29) of cirrus segments, in having P_2 much longer than, often nearly or quite twice as long as, P_1 and composed of 15–18 segments, and in having P_3 similar to P_2 though smaller. As these three forms are all from the Indian Ocean, ranging from Muscat southward to Ceylon and Cargados Carajos, it is possible that they represent in reality the same specific type, or more or less minor variations of the same species.

Decametra laevipinna, *D. studeri*, *D. informis*, and *D. modica* are rather sharply distinguished from the remaining species through having the dorsal transverse ridge on the cirrus segments either continued as far as the antepenultimate segment (*laevipinna*) or narrowing to a single median tubercle or spine on from 4 to 6 segments preceding the penultimate; *laevipinna* appears to be a very distinct species, and *studeri* is probably a good species; but it is quite possible that *informis* from the Malayan region and *modica* from the Indian Ocean may turn out to be at most minor variations of the same specific type.

Of the remaining species, *mylitta* and *mollis* have 20–25 cirrus segments, P_2 with 14–17 (usually 16–17) segments, and the arms 55–75 mm. long. There is little real difference between *mylitta* from the Malayan region and *mollis* from the eastern Indian Ocean, and it is quite possible that they represent in reality the same specific type.

The two small species *parva* and *minima* have 10–15 cirrus segments, P_2 with 8–11 segments, and the arms 35–45 mm. long. It is possible that they represent the same species.

Decametra brevicirra is intermediate between the group including *mylitta* and *mollis* and that including *parva* and *minima*, having 21–23 cirrus segments, but only 12–13 segments in P_2. The arms, however, are only 35 mm. long, indicating that the species is based upon an immature individual. Just what its status is must be left for future determination.

The form herein described as *Oligometra serripinna* var. *macrobrachius* I originally regarded as a species of *Decametra*. As it is sufficiently like some species of *Decametra*—especially *mylitta* and *mollis*—to be easily confused with them I have, as a precautionary measure, inserted it in the key to the species of *Decametra*.

KEY TO THE SPECIES IN THE GENUS DECAMETRA

*a*¹. Longest cirri with more than 15 segments.
  *b*¹. More than 25 cirrus segments.
    *c*¹. P_2 much longer than, often nearly or quite twice as long as, P_1; basal segments of P_2 not carinate; arms 80–110 mm. long.
      *d*¹. Cirrus segments subequal, from half again to twice as broad as long, or sometimes the distal only slightly broader than long; cirri XV–XX, 26–28, 12–14 mm. long; P_1 5–8 mm. long with 13–21 segments; P_2 much larger, stouter, and stiffer, 9–12 mm. long with 16–18 segments; P_3 similar to P_2 but smaller; arms 90–100 mm. long (Cargados Carajos; 55 meters) -------------------- **alaudae** (p. 183)
      *d*². Distalmost cirrus segments about as long as broad.
        *e*¹. Most of the segments of P_2 are from one-third to one-half again as long as broad with prominent, though not spinous, distal ends; cirri XIV–XXI, 23–29, 12–13 mm. long; P_1 4.5 mm. long with 14 segments; P_2 8 mm. long, stouter and stiffer than P_1 though not especially enlarged, wtih 15–17 segments; P_3 6 mm. long with 14 segments; arms about 80 mm. long (Ceylon and the Maldive Islands; 0–58 meters) - **taprobanes** (p. 185)
        *e*². Most of the segments of P_2 are twice as long as broad, with spinous distal angles; cirri XIX, 26–27, 13 mm. long; P_1 very small and weak, 4.5 mm. long; P_2 9 mm. long with 15 segments; P_3 similar to P_2, 6–7 mm. long (Muscat, Arabia; littoral) **arabica** (p. 187)
    *c*². P_1 nearly as long as P_2; P_3 similar to P_2 but a little smaller; aboral margins of the basal segments of P_2 more or less produced as flattened spinulose projections; arms about 70 mm. long (off Clarence River, New South Wales; 64–66 meters) ------------- **zebra** (p. 175)
  *b*². Cirri with 16–26 (usually between 18 and 24) segments.
    *c*¹. More or fewer of the distal cirrus segments with paired tubercles dorsally; P_3 (except in *brevicirra*) longer than P_1.
      *d*¹. Third to seventh or eighth and following cirrus segments about as long as broad, the terminal segments sometimes slightly longer than broad; segments of P_2 with conspicuously everted and spinous distal ends; lower pinnules to at least P_5 stiffened.
        *e*¹. Segments of P_2 beyond the basal not greatly elongated, not becoming more than twice as long as broad; pairs of tubercles on the distal cirrus segments often indistinct or more or lesss fused; cirri XII–XXX, 18–26 (usually 20), 10–13.5 mm. long; P_1 4–5.8 mm. long with 9–17 segments; P_2 6.8–10 mm. long with 12–20 segments; P_3 about as long as P_1 with 13 or 14 segments; arms 40–80 mm. long (southern Japan from Kagoshima to Sagami Bays; 0–137 meters) -------------------- **tigrina** (p. 178)
        *e*². Segments of P_2 much elongated, from the fourth onward being between 2 and 5 times as long as broad; paired tubercles on the distal cirrus segments very distinct; cirri XVI, 22–24, 12–14 mm. long; P_1 7.5–8 mm. long with 16 segments; P_2 13 mm. long with 20 or 21 segments; P_3 7.5 mm. long with 15 segments; arms about 90 mm. long (Suez Bay; 18 meters) -------------------- **chadwicki** (p. 176)
      *d*². Cirrus segments all broader than long, or the terminal sometimes becoming nearly or

quite as long as broad; segments of P_2 only moderately spiny on the distal edge; lower pinnules, except for P_2 and sometimes P_3, not unusually stiff; cirri 10–12 mm. long with 20–25 segments.

e^1. P_2 with 16 or 17 segments and from half again to twice as long as P_1, which has 13–15 segments; arms 55–110 mm. long.

f^1. All the cirrus segments markedly broader than long, the antepenultimate being about one-third again as broad as long; P_3 similar to P_2 but slightly smaller; cirri XIV–XIX, 21–25; P_1 5–6 mm. long with 14 or 15 segments; P_2 9 mm. long with 17 segments; P_3 6–6.5 mm. long with 14 segments; P_4 5 mm. long with 12 or 13 segments; arms 55–75 mm. long (Philippine Islands and Hong Kong to Singapore; ?Borneo; 0–36 meters)-------------------- **mylitta** (p. 188)

f^2. The two to six cirrus segments before the penultimate are scarcely, if at all, longer than broad; P_3 is more like P_4 or P_1 than P_2.

g^1. The 5 or 6 cirrus segments preceding the penultimate are almost or quite as long as broad; cirri XII–XX, 20–23, 10 mm. long; P_1 with 13 or 14 segments; P_2 5–13 mm. long with 14–17 segments; P_3 very similar to P_1 with 15 segments; arms 65 mm. long (Kurrachi to the Maldive Islands; littoral)------- **mollis** (p. 191)

[g^2. The 2 or 3 cirrus segments preceding the penultimate are almost or quite as long as broad; cirri XV, 21–22, about 12 mm. long; P_1 5.5 mm. long with 14 segments; P_2 8.5 mm. long with 16 segments; P_3 5.5 mm. long with 12 segments; the very slender arms are up to 110 mm. long (from the Philippines to the Kei Islands and Amboina; 0–50 meters) ------- **Oligometra serripinna macrobrachius**]

e^2. P_2 with 12 or 13 segments, not much longer than P_1, which has the same number of segments; arms about 35 mm. long; cirri XIV, 21–23 (usually the latter), 8 mm. long; P_1 4.5 mm. long; P_2 6 mm. long; P_3 3 mm. long (Arrakan coast of Burma; ?Ceylon; 0–24 meters) -------------------- **brevicirra** (p. 193)

c^2. Earlier cirrus segments dorsally with a transverse ridge which may persist until the end of the cirrus, or may transform into a single median tubercle or short spine on a few of the segments preceding the penultimate; P_3 shorter than P_1.

d^1. Cirri with 18–23 segments which bear a transverse ridge as far as, and including, the antepenultimate; P_2 entirely smooth; P_1 5.5 mm. long with 14 or 15 segments; P_2 6.5 mm. long with 17 segments; P_3 4.5 mm. long with 14 segments; arms about 50 mm. long (Saleyer; ?Hong Kong; littoral)-------------------- **laevipinna** (p. 197)

d^2. Cirri with not more than 20 segments of which the 4–6 preceding the penultimate bear a single median dorsal spine; distal segments of P_2 with the distal ends more or less spinous.

e^1. P_2 with 18 segments; cirri XII, 16–18, 7 mm. long; P_1 4.5 mm. long; P_2 6 mm. long; P_3 3 mm. long; arms 45 mm. long (Dirk Hartog Island, Western Australia; 13 meters)-------------------- **studeri** (p. 200)

e^2. P_2 with 11–13 segments.

f^1. P_3 shorter, but not smaller and weaker, than P_1; cirri XII, 15–18; P_1 and P_2 with 11 or 12 segments; arms about 40 mm. long (Philippine Islands to Singapore; 0–42 meters)-------------------- **informis** (p. 203)

f^2. P_3 much smaller and weaker, and much less stiff, than P_1; cirri XIV–XVI, 14–20, 7–8 mm. long; P_1 3.5–4.5 mm. long with 11–13 segments; P_2 4.5–5 mm. long with 11 or 13 segments; P_3 3 mm. long with 10–12 segments; arms 35–50 mm. long (Bagamoyo and Mauritius to the Maldive Islands; ?Ceylon; littoral)- **modica** (p. 205)

a^2. Not more than 15 cirrus segments.

b^1. Cirri with 14 or 15 segments; P_1 and P_2 with 11 segments of which the seventh and following are about twice as long as broad; arms 40–45 mm. long (from southwestern Japan southward to the Kei Islands and westward to the Java Sea; 9–90 meters)------ **parva** (p. 195)

b^2. Cirri with 10–12 segments; P_1 and P_2 with 8 or 9 segments; P_2 half again as long as P_1 and P_3, stiff and spinelike, the outer segments about three times as long as broad with long and prominent spires at the prismatic angles; arms 35–40 mm. long (from the Philippine Islands to Celebes, the Borneo Bank, the Kei Islands, and Salomakiëe [Damar] Island; 33–90 meters)-------------------- **minima** (p. 196)

DECAMETRA ZEBRA (H. L. Clark)

Oligometra zebra H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 22 (detailed description; locality), pl. 2, fig. 2.

Decametra zebra H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52 (in key), p. 53 (notes; transferred to *Decametra* at suggestion of A. H. Clark).

Diagnostic features.—The cirri are 12–13 mm. in length with 27–28 segments, all of which are broader than long; P_1 is nearly as long as P_2; P_3 is similar to P_2, but a little smaller; the aboral margins of the basal segments of P_2 are more or less produced as flattened spinulose projections; the arms are about 70 mm. long.

Description.—The centrodorsal is 3 mm. in diameter, with the dorsal pole markedly concave. The cirri are arranged in a single crowded fairly regular marginal row.

The cirri are about XX, 27–28, from 12 to 13 mm. long. All of the component segments are broader than long. The basal segments are nearly square, but distally each successive segment becomes more compressed, ventrally rounded, and dorsally transversely ridged. The transverse ridges are never conspicuous, but become more evident on the last four segments, especially on the penultimate where the transverse ridge forms a well marked opposing spine.

The IBr series are not peculiar, the synarthrial tubercles, however, being quite distinct. The IBr_2 (axillaries) are nearly twice as broad as long. The adjacent IBr series are well separated from each other.

The 10 arms are about 70 mm. long. The brachials are at first quadrilateral, later becoming triangular and then near the tip of the arm again quadrilateral. The synarthrial tubercles are well marked. Neither the distal margins nor the distolateral angles are peculiar, though the latter are evident enough, especially in the terminal half of the arm. The general contour of the arms is quite smooth.

P_1 is about 7 mm. long and is not at all rigid or otherwise peculiar. It consists of 18 segments of which the basal six or seven are broader than long and those succeeding are about as long as broad, or a little longer than broad. The oral margins of the lower segments are barely produced into one or two minute spines, while the aboral margins are inconspicuous, flattened, and a trifle roughened. The eighth–twelfth segments are somewhat prismatic, and the remaining segments are distinctly flattened. P_2 is 9 mm. long with 18–20 segments. It is very similar to P_1 but is obviously stouter, and is clearly the largest pinnule on the arm. The oral margins of the basal segments are smooth, while the aboral margins are more or less produced as flattened spinulose projections. The distal margins of all the segments except the first five or six are finely spinulose. But none of these characteristics are at all conspicuous. P_3 is much like P_2, but it is a little smaller. P_4, which is probably the shortest pinnule on the arm, is only a trifle shorter than P_3. The pinnules succeeding become very slender, from 8 to 9 mm. long with 22 or more segments. On the basal half of the arm the pinnule segments, except for the basal two or three, have distinctly, but finely, spinulose aboral edges and distal margins, but on the outer half of the arm they seem to be quite smooth.

In the dry type specimen the centrodorsal, the basal portion of the cirri, and all the brachials and pinnules are uniformly pale buff or brownish white. The cirri gradually become dull purple at the tip, the lighter color being confined more and more completely to the ventral side of the segments and finally crowded out altogether. The brachial articulations are rich reddish purple, in sharp and handsome contrast to the brachials themselves. The oral surface of the pinnules is very dark, almost black.

Locality.—Australian Fisheries Investigation steamer *Endeavour;* 11 miles east-southeast of Clarence River mouth, New South Wales; 64–66 meters [H. L. Clark, 1916] (1, Austr. M.).

History.—This species was originally described in 1916 by Dr. Hubert Lyman Clark under the name *Oligometra zebra* from a single specimen dredged off the mouth of the Clarence River, New South Wales, in 35–36 fathoms by the Australian Fisheries Investigation steamer *Endeavour.*

DECAMETRA CHADWICKI A. H. Clark

PLATE 26, FIGURES 139, 140

Antedon serripinna CHADWICK, Journ. Linn. Soc. (Zool.), vol. 31, 1908, p. 44 (Suez Bay, 10 fms.; notes).—BOULENGER, Proc. Zool. Soc. London, 1913, p. 88 (Suez Bay, 10 fms.; myzostomes), p. 102 (same).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 5 (identity); Crinoids of the Indian Ocean, 1912, p. 41 (same).

Oligometra serripinna A. H. CLARK, Amer. Nat., vol. 43, 1909, p. 254 (Red Sea; possibly the species of which Moseley analyzed the coloring matter), p. 255 (reported from the Red Sea by Chadwick); Vid. Medd. Naturh. Foren. København, 1909, p. 179 (in part; record from the Red Sea).

Colobometra chadwicki A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 5 (=*Antedon serripinna* Chadwick, 1908), p. 9 (occurs on the northeast coast of Africa), p. 30 (synonymy; description; Suez Bay, 10 fms.); Crinoids of the Indian Ocean, 1912, p. 41 (identity), p. 168 (synonymy; locality).

Colobometra (Prometra) chadwicki A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 322 (compared with *C. [P.] brevicirra*).

Prometra chadwicki A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 125 (in key; range).—GISLÉN, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 28 (comparison with *P. perplexa*).

Decametra chadwicki A. H. CLARK, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (range), p. 104.

Diagnostic features.—The cirri are 12–14 mm. long with 22–24 segments which from the third or fourth onward are about as long as broad; the outer bear dorsally a pair of small erect median tubercles or small spines; P_2 is much longer than P_1 or P_3, 13 mm. long, slender, with 20–21 segments which from the fourth onward are between two and five times as long as broad, with prominently everted and spinous distal ends; the pinnules from P_2 to P_5 are stiffened; the arms are about 90 mm. long.

The stiffened and spiny early pinnules and the rather slender cirri give this species an appearance suggesting a small *Colobometra.*

Description.—The centrodorsal is thin discoidal, with the bare polar area broad and flat, 2 mm. in diameter. The cirrus sockets are arranged in a single crowded marginal row.

The cirri are XVI, 22–24, from 12 mm. to 14 mm. long. The first segment is short and those following gradually increase in length to the third or fourth which, with the remainder, is about as long as broad. The second and following segments have the distal dorsal edge produced into a finely spinous transverse ridge which gradually becomes crescentic in dorsal view, then V-shaped, on the tenth segment parting in the middle, and on the last 4 or 5 before the antepenultimate becoming a pair of small erect median spines. The antepenultimate segment bears a single median spine. The dorsal processes are rather high, reaching about one-quarter of the width of the segments in height. The opposing spine is large and prominent. triangular in lateral view, terminal, arising from the entire dorsal surface of the penultimate segment, in height reaching one-half the width of that segment. The terminal claw is slightly longer than the penultimate segment, stout, strongly curved basally, but becoming straighter distally. The distal ventral edge of the cirrus segments is slightly produced and very finely spinous.

The distal ends of the radials are even with the rim of the centrodorsal. The IBr_1 are oblong, slightly over twice as broad as long, and not in contact basally. The IBr_2 (axillaries) are long, pentagonal, about as long as broad, with the lateral edges nearly or quite as long as those of the IBr_1.

The 10 arms are about 90 mm. in length. The first 2 brachials are subequal, slightly wedge-shaped. The first are about twice as broad as the median length, interiorly united for the proximal half or two-thirds, the distal halves of the interior sides diverging at a right angle. The second are somewhat longer. The first syzygial pair (composed of brachials 3+4) is about as long as broad. The following 5 or 6 brachials are approximately oblong, those succeeding becoming triangular, as long as broad, distally wedge-shaped and about as long as broad, and longer than broad terminally. The IBr series and the brachials in the proximal fourth of the arm have a faint narrow median keel.

P_a is absent. P_1 is from 7.5 mm. to 8 mm. long, very slender and tapering evenly from the base to the tip, composed of 16 segments of which the first is broader than long, the second is about as long as broad, and those following gradually increase in length, after the seventh being 3 times as long as broad; the distal segments have slightly spinous distal ends. P_2 is 13 mm. long, slender (though stouter than P_1) especially distally, with 20 or 21 segments of which the first is not quite so long as broad, the second is slightly longer than broad, and those following increase in length so that the fourth and those succeeding are between 2 and 5 times as long as broad; the fourth or fifth and following have the distal edge and the distal portion of the ventrolateral border prominently everted and spinous; the dorsal (outer) portion of the outer edge of the segments is not produced. P_3 is 7.5 mm. long, as slender as P_1 but stiffened, with 15 segments which resemble those of P_2. P_4 is 6.5 mm. long with 16 segments, resembling P_3 though slightly more slender. P_5 is 6 mm. long, slightly more slender and less stiffened than P_4, but with the same number of segments. The following pinnules resemble P_5, soon slowly increasing in length, slenderness, and the length of the component segments.

The color in alcohol is deep violet, with the cirri a purplish flesh color.

Locality.—Suez Bay; 18 meters; mud; Cyril Crossland [Chadwick, 1908; A. H. Clark, 1909, 1911, 1912, 1918; Boulenger, 1913] (1 U. S. N. M., 27509).

History.—This species was first noticed by Herbert Clifton Chadwick in 1908 who recorded several specimens, under the name *Antedon serripinna,* from a muddy bottom at a depth of 10 fathoms in Suez Bay, where they had been collected by Cyril Crossland. Chadwick said that the cirri consist of 23 segments of which all, from the fifth onward, have a transverse dorsal ridge. As in the specimens of this species (that is, of *Oligometra serripinna*) collected by Prof. Sir William Herdman off the coast of Ceylon the ridge is near the distal end in the first few segments, and becomes median in the later ones. On the last few segments it is represented by a pair of parallel spines, and the penultimate segment bears a strong opposing spine. In relative size the proximal pinnules resemble those of the specimens from Ceylon, but the number of pinnule segments is larger. The second syzygy is between brachials 10+11 or 11+12, and the third is between brachials 16+17.

In a review of Mr. Chadwick's paper on the crinoids of the Sudanese Red Sea published in April 1909, I remarked that the specimens recorded as *Antedon serripinna* differ from the type of *Oligometra serripinna* in the greater number of cirrus segments and, in view of the general constancy of the cirrus characters in this genus, may eventually turn out to be a recognizable form, as may also those recorded under the same name from Ceylon; correlated, as usual, with the more numerous cirrus segments, the lower pinnules also have more numerous segments. In my paper on the crinoids of the Copenhagen Museum published later in 1909 I mentioned that *Oligometra serripinna* had been recorded from the Red Sea.

Thanks to the kindness of Prof. Sir William Herdman the United States National Museum secured one of the specimens upon which Chadwick's record was based. In 1911 in a paper on the crinoids of the coasts of Africa this specimen was described by me as the type of a new species which I called *Colobometra chadwicki*. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Colobometra chadwicki* and gave the synonymy and range. In the appendix to this memoir this species, under the name *C*[*olobometra*]. (*P*[*rometra*].) *chadwicki*, was compared with the new species *Colobometra* (*Prometra*) *brevicirra*.

In 1913 Prof. Charles L. Boulenger described the myzostomes from Chadwick's specimens, which he recorded as *Antedon serripinna*.

In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 *chadwicki* was included in the key to the species of *Prometra* and the range was given.

DECAMETRA TIGRINA (A. H. Clark)

Plate 19, Figure 98; Plate 22, Figure 112; Plate 24, Figures 123, 124; Plate 26, Figure 133

Antedon tigrina A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 147 (description; ?Kagoshima Bay, Japan), p. 148, footnote (Sagami Bay; correctness of original locality established); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 497 (listed).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (listed), pp. 380, 381 (?Kagoshima Bay; detailed description and discussion), pl. 13, fig. 1.

Cyllometra tigrina A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed).

Decametra tigrina A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 164 (synonymy; southern Japan); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in east Asia); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 34 (Toba Harbor, Japan; Japan); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 117 (in key; range).

Prometra perplexa Gislén, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, pp. 2, 27 (description; Mortensen's station 10); p. 68; figs. 15–18, p. 27; fig. 82, pl. 1.

Diagnostic features.—The cirri are 10–13.5 mm. long with 18–26 (most commonly 20) segments of which the seventh or eighth and following are about as long as broad, the terminal sometimes broader than long; the dorsal pairs of tubercles on the distal segments are often indistinct or more or less fused; P_2 is markedly longer than P_1 or P_3 with 12–20 segments of which the outer are not more than twice as long as broad with somewhat overlapping and spinous distal ends; the lower pinnules are stiffened; the arms are 40–80 mm. long.

Description.—The centrodorsal is discoidal, thin, with a rather large bare polar area about 2 mm. broad that is broadly and slightly elevated centrally and also peripherally. The cirrus sockets are arranged in a single or partially double marginal row.

The cirri are XVIII–XXX, usually 20, 10 mm. long. The first segment is short, from three to four times as broad as long, the second is from two and one-half to three times as broad as long, and the third is about twice as broad as long or a little broader. The segments following slowly increase in length so that the seventh or eighth and those succeeding are about as long as broad, or sometimes slightly longer than broad terminally. On the second segment the entire distal dorsal edge is slightly produced and finely serrate. This production of the distal dorsal edge slowly increases and on the sixth or seventh becomes somewhat higher at the two ends than in the middle, the crest being slightly concave, and at the same time moves proximally from the end of the segments. From this point onward the transverse ridge shortens and at the same time moves more and more proximally so that on or about the twelfth segment it becomes a very short median transverse ridge, usually more or less distinctly divided into two tubercles, and on the last three to five or six segments before the penultimate becomes a small median dorsal tubercle or blunt spine. The opposing spine is much larger than the spines on the segments preceding, triangular, sharp and erect, arising from the central half of the penultimate segment, and equal in height to from one-third to one-half the width of that segment. The terminal claw is about as long as the penultimate segment, and is stout and strongly curved.

The radials are usually concealed by the centrodorsal, more rarely just visible in the interradial angles of the calyx. The IBr_1 are somewhat over twice as broad as long, well rounded dorsally and well separated laterally. The IBr_2 (axillaries) are pentagonal, over twice as broad as long. There is a slightly developed synarthrial tubercle.

The 10 arms are from 40 mm. to 50 mm. long. The first brachials are wedge-shaped, with the shorter side in, and are almost completely united interiorly. The second brachials are almost oblong. The first syzygial pair (composed of brachials 3+4) is about as long as broad. The next 2 brachials are oblong, not so long as broad, and those succeeding become wedge-shaped and after the eighth triangular, nearly as long as broad, in the distal portion of the arm gradually becoming wedge-shaped again and elongate distally. From the eighth onward the brachials have abruptly everted distal ends which stand out at right angles to the axis of the arm and are furnished with a rather broad border of fine spines; this feature gradually dies away in the distal portion of the arm.

Syzygies occur between brachials 3+4, 9+10 and 14+15, and distally at intervals of 4 muscular articulations.

P_a is absent. P_1 is 5 mm. long, slender and tapering gradually from the base to the tip, with 13 segments of which the first 3 or 4 are about as long as broad and those following rapidly increase in length, becoming very elongate distally. P_2 is about 10 mm. long, much longer and considerably stouter than any of the other pinnules, with 12–20 segments of which the basal 2 are about as long as broad and the remainder are elongate, though not more than twice as long as broad; the distal ends of the segments overlap somewhat, especially dorsally, and are furnished with numerous fine spines. P_3 is about as long as P_1; the segments, which basally are about as long as broad, become progressively elongated, but the length does not exceed twice the width. P_4 and the following pinnules are short, about 3.5 mm. long, and very slender; the basal 4 or 5 segments are about as long as broad and the following gradually increase in length. Distally the pinnules gradually increase in length, the distal pinnules being 9 mm. or 10 mm. long and very slender, with the first segment not so long as broad, the second about as long as broad, and the remainder becoming progressively elongated. The lower and middle pinnules have the distal edges of the segments armed with small spines, but this feature becomes less prominent on the distal pinnules.

The color in alcohol is whitish, the brachials broadly edged with deep reddish brown. The IBr series and proximal 6 or 7 brachials are purple with a broad median band of white. The lower pinnules are white, reddish purple, or banded, the distal pinnules usually purplish or reddish brown. The cirri are light purplish.

Notes.—Gislén described his *Prometra perplexa* from Mortensen's station 10 in the following terms: The centrodorsal is discoidal, 2 mm. in diameter, with the bare dorsal pole 1.1 mm. in diameter, flattened with some low and indistinct tubercles. The cirri are arranged in one and a partial second marginal rows. The cirri are XXII, 20–26, 13.5 mm. long. The three first segments are broader than long, the fourth is about as long as broad, and those following are similar. From the fifth onward the segments bear a dorsal arched transverse ridge which in lateral view appears as a dorsal spine with a small prominence proximal to it (about the sixth-ninth segments). From about the fourteenth segment there is a simple dorsal spine compressed laterally so as to form a longitudinal crest. The opposing spine is long and sharp, in height equal to about two-thirds the width of the penultimate segment. The terminal claw is as long as, or slightly longer than, the penultimate segment and is weakly curved. The radials are visible as narrow bands about six times as broad as long beyond the rim of the centrodorsal. The IBr$_1$ are twice as broad as long, free laterally, and forming with the axillary a weak synarthrial prominence. The 10 arms are 80 mm. long. The proximal portion of the arms is smooth or inconspicuously swollen at the articulations. Syzygies occur between brachials 3+4, 9+10, and distally at intervals of 3 or 4 muscular articulations. P_1 is smooth, from 4.5 to 5.8 mm. long, with 14–17 segments. P_2 is from 6.8 to 8 mm. long with 16–19 segments of which the longest are twice as long as broad. From the fourth onward the segments have the distal ends slightly expanded and provided with a spiny crown. P_3 is about 4.5 mm. long with 13 or 14 segments. P_a is lacking. The diameter of the disk is 4.5 mm. The color is whitish with closely set violet spots.

In another specimen from the same locality, as described by Gislén, the cirri are XXV, 12–19, 3.5 to 7.5 mm. long. The longest segments are only very slightly longer than broad. From the second segment onward there is a stout transverse ridge which on about the eleventh is transformed into a dorsal spine. The 10 arms are from 30 to

35 mm. long. The distal intersyzygial interval is 4 muscular articulations. P_1 is 2.5 mm. long with 8 segments. P_2 is 4 mm. long with 11 segments which have distinct spiny whorls on the distal ends. P_3 is 3 mm. long with 9 segments. P_a is lacking. The disk is 2.5 mm. in diameter. The color is white with one or two small violet spots on each arm.

The more nearly perfect of the two specimens from "Eastern Asia" has the arms 55 mm. long.

Hartlaub described the specimen from ?Kagoshima Bay examined by him as follows: The centrodorsal is flat discoidal, about 2 mm. in diameter, with the cirri arranged in a single marginal row. The cirri are XII–XV, 18 (only one is preserved), 8 mm. long. They are short. The segments are fairly uniform, somewhat longer in the distal than in the proximal half of the cirri, and from the ninth onward bear a dorsal spine. The opposing spine is well developed. The radials are slightly visible. The IBr_1 are short discoidal, laterally entirely free. The IBr_2 (axillaries) are pentagonal, rather short, broadening distally. There is a feebly developed synarthrial tubercle. The 10 arms are 40–45 mm. long. The first brachials are short, almost discoidal, interiorly united basally. The second brachials are of similar form and are scarcely longer. The first syzygial pair (composed of brachials 3+4) is likewise short. Following this are three short discoidal brachials, then two or three intermediate between these and the markedly triangular brachials. The brachials remain triangular at least to the twenty-second brachial, beyond which the arms are not preserved. All these brachials are short. The union of the brachials as far as the tenth or eleventh is smooth, but then the distal edge acquires a high proximally directed tubercular eversion which suddenly changes the previously smooth dorsal profile into a very rough one. Syzygies occur between brachials 3+4, 9+10, 14+15, and 19+20, though with variations. Thus on one arm they occur between brachials 3+4, 12+13, 19+20, 24+25, and so on. P_1 is 4 mm. long with 9 segments of which the basal are short and thick, those in the middle are elongated, and the terminal are somewhat shortened; the pinnule is very finely pointed. P_a is absent. P_2 is at least twice as long as, and markedly thicker than, P_1. The best preserved, though unfortunately not entire, P_2 has 9 segments which from the fourth onward are longer than broad and have somewhat thickened very finely dentate distal ends, resembling those of *Oligometra serripinna*. P_3 is markedly weaker than P_2; it is composed of segments of similar form, mostly elongated. It is scarcely longer than P_1. P_4 is shorter than P_3. From this point the length of the pinnules appears to increase, while the thickness becomes very slight. In the distal pinnules the segments, with the exception of the basal, are elongated. The disk is about 5 mm. in diameter and is deeply incised. Sacculi are numerous and rather large. The color in alcohol is reddish brown with a whitish longitudinal stripe on the dorsal surface of the elements of the IBr series and first brachials. With the eversion of the distal edges of the brachials this stripe passes over into a white spotting. The centrodorsal is light brown, and the cirri are white. Two regenerated arms are entirely uniform white from the point of fracture. The perisome is dark brown.

In the specimen collected by Professor Doflein near Misaki the cirri are XIII, 17–18, from 7 to 8 mm. long; the distal segments are slightly broader than, or about as long as, broad. The arms are 55 mm. long. P_2 is slender, but stiff, 9 mm. long with 18 segments of which the fourth and following are longer than broad, those in the outer part of the pinnule being twice as long as broad; the dorsal portion of the distal edge of the fourth or fifth and following segments is produced and spinous. P_1 is 4.5 mm. long, very delicate, with 14 segments which distally become twice as long as broad. P_3 may resemble P_2, or it may be shorter though of the same character; the following pinnules are short, but stiffened. The long proximal pinnules are recurved distally.

Localities.—Mortensen's station 10; off the Goto Islands, Korean Straits (lat. 33°41′ N., long. 128°50′ E.); 137 meters; sand; May 17, 1914 [Gislén, 1927].

Eastern Asia; Captain Suensson, April 19, 1911 (2, C. M.).

?Kagoshima Bay, Japan; United States North Pacific Exploring Expedition, under Capt. John Rodgers, U. S. Navy [A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1915, 1918] (19, U. S. N. M., 3033, 22642).

?Kagoshima Bay, Japan; United States North Pacific Exploring Expedition [Hartlaub, 1912].

Toba Harbor, Japan, in Shima prefecture, 70 miles east-southeast of Kyoto [A. H. Clark, 1913] (1, B. M.).

Albatross station 3727; Sagami Bay, Japan; Omai Zaki Light bearing N. 17° E., 9.7 miles distant; 62 meters; mud, coarse black sand, and shells; May 16, 1900 [A. H. Clark, 1907 (as Sagami Bay)] (3, U. S. N. M., 35291; M. C. Z., 279).

Albatross station 3729; Sagami Bay; Omai Zaki Light bearing N. 17° E., 12.7 miles distant; 62 meters; mud and gravel; May 16, 1900 [A. H. Clark, 1907 (as Sagami Bay)] (1, U. S. N. M., 36053).

Sagami Bay, near Misaki; 10–15 meters; Prof. Franz Doflein, October 11, 1904 (1, Munich Mus., 293).

Sagami Bay, Japan [A. H. Clark, 1907]; refers to the specimens from *Albatross* stations 3727 and 3729.

Sagami Bay, Japan (2, M. C. Z., 335, 336).

Japan [A. H. Clark, 1913] (2, B. M.).

Geographical range.—Southern Japan from the Goto Islands eastward to Sagami Bay.

Bathymetrical range.—From shallow water down to 137 meters.

History.—This species was first described as *Antedon tigrina* by me from 19 specimens labeled, with a query, Kagoshima Bay that had been collected by the United States North Pacific Exploring Expedition under Capt. John Rodgers in 1852–1855. In a footnote appended to the original description I said that since the description was put in type I had examined several other specimens of the species taken in Sagami Bay in 1900, so I had no doubt the original specimens did come from Japan. These specimens from Sagami Bay were from the *Albatross* collections, and they were shown to me by Dr. Hubert Lyman Clark at the Museum of Comparative Zoology at Cambridge, Mass. The collection of crinoids made by the *Albatross* on the coasts of southern Japan in 1900 had been turned over to Dr. Clark for study, and he had brought them with him from Oberlin to the Museum of Comparative Zoology. On learning that I was engaged in studying the much larger collection made in southern Japan by the *Albatross* in 1906, Dr. Clark, with his characteristic courtesy and generosity, turned over to me all the crinoids in his custody.

In a paper published in 1908 I listed *Cyllometra tigrina* as among the crinoids of southern Japan. In a revision of the family Himerometridae published in 1909 this species was listed by me as *Cyllometra tigrina*. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed this form as *Decametra tigrina* and gave the original reference and habitat.

Dr. Clemens Hartlaub in his memoir on the comatulids of the *Blake* expedition published in 1912 described in detail and figured a specimen of *Antedon tigrina* from the original lot from ?Kagoshima Bay. This specimen had been sent by the Museum of Comparative Zoology to Dr. P. H. Carpenter with the Blake collection, and after Carpenter's death had been turned over to Hartlaub.

In a paper on the crinoids of the British Museum published in 1913 I recorded a specimen of *Decametra tigrina* from Toba Harbor, Japan, and two specimens, one large and one small, from "Japan." *Decametra tigrina* was listed by me as an east Asiatic species in 1913, and as a southern Japanese species in 1915. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *tigrina* in the key to the species of *Decametra* and gave the habitat.

In 1927 Dr. Torsten Gislén described *Prometra perplexa* from a large specimen from Mortensen's station 10, at the same time assigning to his new species a smaller specimen from the same station. I cannot see that *Prometra perplexa* differs in any way from *P. tigrina*, except that in the type specimen the longest cirri have a few more segments than in the type specimen of *tigrina*. Undoubtedly Dr. Gislén failed to recognize the identity of his specimens with my *tigrina* for the reason that in the key to the genera of the family Colobometridae in the *Siboga* report his specimens would fall in the genus *Prometra*, while in the same report I had included *tigrina* in the genus *Decametra*.

DECAMETRA ALAUDAE A. H. Clark

PLATE 23, FIGURES 114, 115

Decametra alaudae A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast coast of Africa), p. 33 (description; Cargados Carajos, 30 fms.); Crinoids of the Indian Ocean, 1912, p. 161 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 35 (published references to specimens in the B. M.; description; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 117 (in key; range); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, May 1929, p. 642, pl. 44, fig. 14 (Cargados Carajos; notes); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (range), p. 104.

Diagnostic features.—The cirri are 12–14 mm. long with 26–28 segments, which are subequal, from half again to twice as broad as long, the distal sometimes only slightly broader than long; P_2 is much larger, stouter, and stiffer than P_1, 9–12 mm. long with 16–18 segments; P_3 is similar to P_2, but smaller; the arms are 90–100 mm. long.

Description.—The cirri are XV, 26, small and slender. All the segments are subequal, about twice as broad as long.

The 10 arms are 90 mm. long and resemble those of *D. taprobanes*.

P_a is absent. P_1 is slender and flagellate, 8 mm. long with 21 segments all of which are about as long as broad. P_2 is much larger, stouter, and stiffer, tapering very gradually, 11 mm. long with 16 segments of which the fifth-seventh are half again as long as broad and the remainder are about as long as broad or broader than long; from the fourth onward the segments have projecting distal edges and distal angles so that the pinnule as a whole reminds one strongly of P_2 in the genus *Cenometra*. P_3 is similar to P_2 but smaller and much more slender and flagellate distally, 10 mm. long with 19 segments. P_4 and the following pinnules are 6 mm. long, small, weak and slender. The distal pinnules are very slender, 10 mm. in length.

Notes.—The preceding description is the original description drawn up in the British Museum from the type specimen.

In 1928 the British Museum submitted to me, thanks to the kindness of C. C. A. Monro, two additional specimens from the type locality for study. One of these was large and one was much smaller. In the larger individual the centrodorsal is thin discoidal, with the dorsal pole broad and sunken in such a way that only the outer border rises to the lower edges of the cirrus sockets. The cirri are arranged in a fairly regular marginal row. The cirri are XX, 26, about 12 mm. long. The segments in the proximal third of the cirri are about twice as broad as long, those succeeding becoming about half again as broad as long, and the distal being only slightly broader than long. On the third or fourth segment a ridge appears on the dorsal side in the shape of a broad V with a rounded apex; the two ends of the V lie at the distal outer angles of the segment, and the rounded apex is just within the middle of the proximal border. Almost immediately the apex of the V disappears, so that only two short diagonal ridges are left, which, on about the twelfth segment, become reduced to a pair of small tubercles, those on the antepenultimate fusing into a single median tubercle. The radials in the midradial line are even with the rim of the centrodorsal. The IBr_1 are short, about four times as broad as long, with the distal border somewhat concave and the lateral edges rather broadly in contact basally, diverging from the point of contact at an angle of about 45°. The IBr_2 (axillaries) are almost triangular, about twice as broad as long. The short lateral edges make an angle of about 90° with those of the IBr_1. The 10 arms are about 100 mm. long. They remain of uniform width for an unusual distance, and then taper very slowly. P_1 is 7 mm. long with 17 segments of which the first is twice as broad as long, the fourth is about as long as broad, and those following are about half again as long as broad. The pinnule is rather stout basally, but tapers rapidly in the proximal third, and more gradually from that point onward; it does not become flagellate distally. P_2 is 12 mm. long, much larger, stouter, and stiffer than P_1, with about 18 segments of which the first is half again as broad as long, the fourth is very slightly longer than broad, and those following are about one-third again as long as broad. From the fourth onward the segments have the distal edge abruptly and prominently everted and dentate. P_3 resembles P_2 but is shorter and less stout. Usually the difference is only slight, though it may be considerable. P_4 may be much shorter, more slender, and less stiffened than P_3, resembling the pinnules succeeding, or it may be intermediate between P_3 and the following pinnules. The color in alcohol is purplish brown with a narrow white band running directly across the arm in the middle of each brachial. In the proximal fourth of the arms this light transverse band on the pinnule side of the brachials suddenly expands, forming a ring about a large circular brown spot. The enlarged lower pinnules are light with a central dark dot on more or fewer of the basal segments. Some of the arms are light with narrow brown bands along the articulations. The centrodorsal and the cirri are uniform in color and rather dark.

In another specimen in the British Museum from Cargados Carajos in 55 meters the cirri are XVII, 27–28, 14 mm. long, moderately slender. All the segments are subequal, about half again as broad as long. On the sixth or seventh segment a transverse ridge begins to develop which becomes a pair of small low tubercles on the tenth or twelfth. The 10 arms are 90 mm. long. P_a is absent. P_1 is slender, small, and weak, 5 mm. long with 13 segments. P_2 is the largest pinnule, though it is not especially enlarged. It is slender and distally flagellate, 9 mm. long with 18 segments most of which are nearly twice as long as broad. The outer segments have slightly prominent distal edges, and especially distal angles. P_3 is intermediate between P_1 and P_2. P_4 and the following pinnules are small and weak. The distal pinnules are very slender, 9 mm. long.

Localities.—Cargados Carajos; 55 meters; *Sea Lark;* Prof. J. Stanley Gardiner [A. H. Clark, 1911, 1912, 1913, 1918] (3, B. M.).

Cargados Carajos; *Sea Lark;* Prof. J. Stanley Gardiner [A. H. Clark, 1929] (2, B. M.).

History.—Decametra alaudae was first described in a paper by me on the crinoids of the coasts of Africa published in 1911. The description was based on a specimen in the British Museum that had been collected by Prof. J. Stanley Gardiner on the *Sea Lark* expedition at Cargados Carajos in 30 fathoms. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed this species and gave the original reference and habitat. In my paper on the crinoids of the British Museum published in 1913 I redescribed this species and gave notes on a second specimen from the type locality. In my report on the unstalked crinoids of the *Siboga* expedition this species was included in the key to the species of the genus *Decametra* and the habitat was given. In 1929 I recorded two additional specimens from the type locality and gave extensive notes on the larger of the two.

DECAMETRA TAPROBANES (A. H. Clark)

Plate 24, Figures 119, 120; Plate 25, Figure 130

[See also vol. 1, pt. 2, figs. 486, 487 (pinnule tip), p. 269.]

Antedon laevissima (part) Bell, *in* Gardiner, Fauna and geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 224 (Fadiffolu, Muhlos, Maldives).

Cyllometra taprobanes A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 641 (off Colombo Light House, Ceylon, 26½ fms.; description).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52.

Decametra taprobanes A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 33 (arms compared with those of *D. alaudae*); Crinoids of the Indian Ocean, 1912, p. 40 (=*Antedon laevissima* Bell, 1902, in part), p. 159 (synonymy; description; localities), fig. 23, p. 159; Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 36 (published reference to specimens in the B. M.; Fadiffolu, Muhlos, Maldives; notes).—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 93 (occurs at Ceylon).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 117 (in key; range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (range), p. 103.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52.

Diagnostic features.—The cirri are 12–13 mm. long with 23–29 segments of which the three or four outermost are about as long as broad; P_2 is almost twice as long as P_1, stouter and stiffer, though not especially enlarged, 8 mm. long with 15–17 segments; P_3 is 6 mm. long with 14 segments; the arms are about 80 mm. long.

Description.—The centrodorsal is thin discoidal, with the bare polar area flat and from 2 to 3 mm. in diameter. The cirrus sockets are arranged in a single slightly irregular marginal row.

The cirri are XX–XXI, 25–29, 12 or 13 mm. long. The first segment is short, the next is about two and one-half times as broad as long, and those following slowly increase in length to the fifth or sixth, which is twice as broad as long, and the tenth or twelfth, which is half again as broad as long, still further increasing so that the antepenultimate and one or two of the preceding segments are about as long as broad. The fifth-seventh and succeeding segments have the distal dorsal edge prominent, forming a low tranverse ridge which slowly moves anteriorly, attaining a median position on about the twelfth, and gradually narrows distally, becoming reduced to a small median tubercle on the last twelve. The opposing spine is prominent, rather slender, median, equal in height to about half the width of the penultimate segment. The terminal claw is slightly longer than the penultimate segment, moderately slender and moderately curved, rather more so proximally than distally.

The radials project very slightly beyond the centrodorsal and are slightly separated distally. The IBr_1 are oblong or slightly trapezoidal, four times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long. Synarthrial tubercles are moderately developed.

The 10 arms are about 80 mm. long. The distal ends of the brachials are only very slightly, if at all produced.

P_a is absent. P_1 is 4.5 mm. long, small and slender, with about 14 segments of which the first is short, the second is slightly longer, the third is about as long as broad, and those in the distal portion are half again as long as broad. P_2 is 8 mm. long, stouter and stiffer than P_1, though not especially enlarged, with 15–17 segments, of which the first is short, the second and third are about as long as broad, and the remainder are from one-third to one-half again as long as broad, becoming again somewhat shorter at the extreme tip; the segments in the distal half have slightly enlarged distal ends. P_3 is 6 mm. long, less stout than P_2 though otherwise similar to it, with 14 segments. P_4 is 5 mm. long, slightly less stout than P_3 but similar to it, with 12 segments. P_5 and the following pinnules are 4 mm. long, about as stout as P_4 but not stiffened, with 12 segments which at first are short, becoming about as long as broad on the third, with the remainder longer than broad and half again as long as broad in the distal half. The distal ends of the component segments are slightly everted and spinous. The distal pinnules are 7 mm. long with smooth segments.

Notes.—In one of the specimens from Muhlos, Maldives, the cirri are XIV, 24. P_1 is soft and flexible. P_3 resembles P_2, but is smaller.

In another specimen from the same locality there are 23 cirrus segments. P_2 is much enlarged, but P_1 and P_3 are also enlarged somewhat.

Localities.—*Investigator* station 152; 11.5 miles S. 83° W. of Colombo Light House, Ceylon; 48 meters; sand, shells, and coral; December 12, 1893 [A. H. Clark, 1912, 1918] (6, U. S. N. M., 25483; I. M.).

Investigator station 59; off the southern coast of Ceylon (lat. 6°06′30″ N., long. 81°23′ E.); 58 meters; sand, shells, and coral; November 11, 1889 [A. H. Clark, 1912, 1918] (1, I. M.).

Fadiffolu, Muhlos, Maldives; J. Stanley Gardiner [Bell, 1902; A. H. Clark, 1912, 1913] (1, B. M.).

Muhlos, Maldives; J. Stanley Gardiner [Bell, 1902; A. H. Clark, 1912, 1913] (3, B. M.).

Investigator; ?India (probably Ceylon) [A. H. Clark, 1912] (1, I. M.).

Geographical range.—Ceylon and the Maldive Islands.

Bathymetrical range.—From the shore line down to 58 meters.

History.—The first mention of this species was by Prof. F. Jeffrey Bell, who recorded specimens of it from the Maldive Islands under the name of *Antedon laevissima* in 1902.

The species was first described under the name *Cyllometra taprobanes* by me in a preliminary paper on the crinoids of the Indian Museum published in 1909. The only locality given in the original description was off Colombo Light House, Ceylon, in 26½ fathoms. In 1911 I compared the arms of my new species *Decametra alaudae* with those of *Decametra taprobanes* and said that the former appears to be most closely related to the latter. In my memoir on the crinoids of the Indian Ocean published in 1912 I redescribed and figured *D. taprobanes* and identified with it specimens I had examined at the British Museum in 1910 that had been identified as *Antedon laevissima* by Bell. These specimens had come from the Maldive Islands. I listed specimens from off Colombo Light House, Ceylon, in 26½ fathoms; from south of Ceylon in 32 fathoms; from ?India; from Fadiffolu, Muhlos, Maldives; and from Muhlos, Maldives. In my paper on the crinoids of the British Museum published in 1913 I recorded specimens of *Decametra taprobanes* from Fadiffolu, Muhlos, Maldives, and from Muhlos, Maldives, that had been previously recorded by Bell as *Antedon laevissima.* In my report on the crinoids of the *Siboga* expedition published in 1918 I included *taprobanes* in the key to the species of the genus *Decametra*, giving as the locality Ceylon.

DECAMETRA ARABICA A. H. Clark

Decametra arabica A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 161 (*Antedon carinata* B. M., MS.; description; Muscat); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 36 (same); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 117 (in key; range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 100 (range), p. 104.

Antedon carinata (Brit. Mus. MS.) A. H. CLARK, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 36.

Diagnostic features.—The cirri are 13 mm. long with 26 or 27 segments of which the proximal are about twice as broad as long and the terminal are about as long as broad; the ninth or tenth and following bear small paired dorsal spines; P_2 is twice as long as the small and weak P_1, slender, though stiffened, with 15 segments most of which are twice as long as broad; P_3 is similar to P_2 but shorter; the arms are 110 mm. long.

Description.—The cirri are XIX, 26–27, 13 mm. long, and are slender. The proximal segments are about twice as broad as long, and the terminal segments are about as long as broad. The ninth or tenth and following segments bear small paired dorsal spines.

The 10 arms are 110 mm. long and resemble those of the other species of the genus.

P_a is absent. P_1 is very small and weak, 4.5 mm. long. P_2 is 9 mm. long and is composed of 15 segments most of which are twice as long as broad with the distal edges produced and spinous and the distal angles produced, suggesting the conditions seen in *Oligometra serripinna*. The pinnule, though stiff, is comparatively slender and tapers evenly to the tip. P_3 is similar to P_2 but shorter, from 6 to 7 mm. long. P_4 is 4.5 mm. long. P_5 is similar to P_4 but shorter. The pinnules following are small and weak. The slender distal pinnules are 9.5 mm. long.

The color in alcohol is yellow, narrowly but frequently banded with purple, the cirri purplish; or, purple and yellow in large blotches.

Locality.—Muscat, Arabia [A. H. Clark, 1912, 1913, 1918] (16, B. M.).

History.—This species was described by me in my memoir on the crinoids of the Indian Ocean published in 1912, and was redescribed in a paper on the crinoids of the British Museum published in 1913. It was included in the key to the species of *Decametra* in my report on the crinoids of the *Siboga* expedition published in 1918.

DECAMETRA MYLITTA A. H. Clark

PLATE 22, FIGURE 110; PLATE 23, FIGURES 116, 117; PLATE 24, FIGURE 118

?*Comatula laevissima* GRUBE, Jahresb. schlesisch. Ges. vaterl. Cultur, 1875, p. 74 (description; North Borneo).—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 746 (correctly referred by Bell to *Antedon*.)

?*Antedon laevissima* BELL, Proc. Zool. Soc. London, 1882, p. 533 (listed).—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 746; *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 54 (10-armed species), p. 193 (in key), p. 366 (bathymetrical range), p. 378 (Borneo).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 34 (of P. H. Carpenter, 1888=*Amphimetra milberti* [error]), p. 40 (of Bell, 1902 = *Amphimetra producta* + *A. molleri* + *Decametra taprobanes* + *D. möbiusi*), p. 289 (of Bell, 1902; account quoted); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 83 (of Bell, 1902 = *Amphimetra flora* + *Decametra möbiusi* + *D. taprobanes;* B. M., MS. = *Amphimetra producta*).

?*Amphimetra laevissima* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 7 (listed); Crinoids of the Indian Ocean, 1912, p. 112 (North Borneo).

Decametra mylitta A. H. CLARK, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 36 (description; *Siboga* station 99); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 117 (in key; range), p. 118 (detailed description; station 99; also *Albatross* station 5139), p. 272 (listed); pl. 20, fig. 50.—GISLÉN, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 30 (no locality; notes).

Diagnostic features.—The cirri are 10–11 mm. long with 21–23 segments all of which are markedly broader than long; P_2 is 9 mm. long with 17 segments, much longer and stronger than the small and weak P_1; P_3 is about two-thirds as long as P_2, which it resembles, and is composed of 14 segments; the arms are 55–75 mm. long.

Description.—The centrodorsal is discoidal with the flat dorsal pole 1.5 mm. in diameter. The cirrus sockets are arranged in two closely crowded alternating rows.

The cirri are XIX, 21–23, from 10 to 11 mm. long. The cirrus segments are subequal in length, the first very short, the second slightly longer, the third and following about twice as broad as long or slightly broader, the last three before the penultimate increasing slightly in length so that the antepenultimate is about one-third again as broad as long. The earlier segments have the dorsal surface swollen and truncated distally so that the dorsal profile is serrate. After the first three the dorsal profile of the individual segments becomes straighter, making a considerable angle with the longitudinal axis of the cirrus, and the distal edge becomes straight, forming a very finely spinous transverse ridge which, however, is not raised above the general dorsal surface of the segment. This transverse ridge becomes gradually more and more marked, at the same time moving more and more toward the center of the dorsal surface, at the ninth segment becoming median and beginning to become slightly concave in profile, and after the fourteenth resolving itself into two prominent entirely distinct tubercles situated side by side, the distance between the apices of these tubercles being about equal to the distance from either apex to the lateral border of the segments. Distally these tubercles gradually move toward each other, at the same time moving nearer and nearer the proximal margin of the segments. On the fourth segment before the penultimate the tubercles merge into a single transversely elongate tubercle which becomes less and less elongate, and on the antepenultimate becomes a single small tubercle situated near the proximal margin of the segment. As a whole the cirri are moderately stout. Although the dorsal profile is serrate, in lateral view no distinct dorsal processes are seen except in the distal half, where the tubercles appear as minute dorsal processes.

The 10 arms are 75 mm. long and resemble those of the other large species of the genus.

P_1 is 5 mm. long, small and weak, tapering with moderate rapidity in the proximal half and becoming very slender in the distal half, composed of 14 segments of which the first is short and those following gradually increase in length, becoming about as long as broad on the fourth and fifth and distally about twice as long as broad. The pinnule is slightly prismatic. P_2 is 9 mm. long with 17 segments, not greatly larger than P_1 basally but tapering evenly from the base to the tip; the first two segments are slightly broader than those following, much broader than long, the third is slightly broader than long, the fourth is slightly longer than broad, and the following are about half again as long as broad, becoming twice as long as broad toward the end of the pinnule; the pinnule is rounded prismatic; the fourth and following segments have slightly produced and spinous distal ends, this feature gradually increasing in extent distally and being most marked at the prismatic angles. P_3 is 6 mm. long with 14 segments, similar to P_2 but very slightly smaller. P_4 is 5 mm. long with 13 segments, similar to P_3 but slightly smaller. P_5 is 4.5 mm. long with 14 segments, resembling P_4 but with proportionately shorter segments. P_6 is 4 mm. long with 15 segments, resembling P_5 but with proportionately shorter segments. The following pinnules are similar to P_6. The distal pinnules are very slender, 7 mm. long with 21 segments of which the longest are about twice as long as broad.

The color in alcohol is light yellowish, banded with purple at the brachial articulations.

Notes.—Another specimen from the type locality has the arms 75 mm. long and the cirri XIV, 23–25, 11 mm. long. As in the type specimen, the first cirrus segment is strongly compressed laterally through crowding by those on either side. P_1 is 6 mm. long with 15 segments. P_2 is 9 mm. long with 17 segments. P_3 is 6.5 mm. long with 14 segments. P_4 is 5 mm. long with 12 segments. P_5 is 4.5 mm. long with 13 segments.

The two other specimens from the type locality are similar to these.

The specimens from Hong Kong have 20–22 cirrus segments.

The specimen from *Albatross* station 5139 has the arms 57 mm. long. It agrees with one of those from the type locality in having the cirrus segments somewhat longer than usual, and more like those of *D. mollis.*

Of the two specimens from Singapore the larger has the arms 55 mm. long and the smaller has the arms 30 mm. long.

In a specimen in the Upsala Museum, as described by Gislén, the cirri are XVII, 21, from 8 to 9 mm. long, arranged in two rows on the centrodorsal. In the longest (distal) segments the length is rarely more than two-thirds or three-quarters of the width. The 10 arms are 70 mm. long. P_a is lacking. P_1 is 4.4 mm. long with 12 segments of which the longest is half again as long as broad. P_2 is 6.5 mm. long with 13 segments. P_3 is 5.0 mm. long with 12 segments. The proximal pinnules are somewhat compressed and flagellate with the outer segments provided with spiny whorls at their distal ends. Gislén said that this specimen is remarkable for the variation in the proximal pinnules. On one arm P_1 is 4.2 mm. long with 13 segments. P_2 is 4.2 mm. long with 12 segments. P_3 is 2.5 mm. long with 9 segments.

Remarks.—This species is most closely related to *D. mollis* from Kurrachi, from which it differs in having the cirri slightly stouter with most of the segments twice as broad as long or even somewhat broader instead of only slightly broader than long as in *D. mollis;* in having the proximal pinnules, while of about the same proportions as those of *D. mollis*, relatively longer and stouter, and composed of somewhat shorter segments; and in having the synarthrial tubercles less marked.

It is possible that *D. mylitta* is only a variety of *D. mollis*, and it may be that in reality they are identical.

Localities.—Hong Kong (2, C. M.).

Siboga station 99; anchorage off North Ubian Island (lat. 6°07′30″ N., long. 120°26′00″ E.); 16–23 meters; lithothamnion bottom; June 28–30, 1899 [A. H. Clark, 1912, 1918] (4, U. S. N. M., E. 388; Amsterdam Mus.).

Albatross station 5139; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 51° W., 3.6 miles distant (lat. 6°06′00″ N., long. 121°02′30″ E.); 36 meters; coral sand; February 14, 1908 [A. H. Clark, 1918] (1, U. S. N. M., 35338).

Singapore; Svend Gad (2).

North Borneo [Grube, 1875; Bell, 1882; P. H. Carpenter, 1883, 1888; A. H. Clark, 1909, 1912, 1913].

No locality [Gislén, 1927].

Geographical range.—From Hong Kong and the Philippine Islands to Singapore and ?Borneo.

Bathymetrical range.—From shallow water down to 36 meters.

History.—It is probable that Professor Grube's *Comatula laevissima*, described from North Borneo in 1875, was based in part upon this species. *Comatula laevissima* was described from two specimens which, through the kindness of Professor Schneider, Grube's successor at Breslau, were later examined by Dr. P. H. Carpenter. One of these was a specimen of *Amphimetra molleri* (see Part 4a, page 349). The other, according to Carpenter, agreed pretty closely with it in the characters of the cirri and in the short brachials, but instead of being entirely flesh-colored it was banded with violet on each brachial, it had no synarthrial tubercles, and the segments of the lower pinnules were sharply carinate—that is, the lower pinnules were sharply prismatic.

From the characters as given, especially the strikingly smooth appearance, the color, the prismatic lower pinnules, and the similarity of the cirri to those of *Amphimetra molleri*, this second specimen of *Comatula laevissima* would appear to be a species of *Decametra*, probably *D. mylitta*. *In D. mylitta* the cirri are XIX, 21–25, the arms are 75 mm. long, P_2 has 15–17 segments, and P_3 resembles P_2 and is longer than P_1. The lower pinnules are strongly prismatic. The sharp prismatic ridge probably is what induced Carpenter to call them carinate.

Decametra mylitta was described by me in 1912 from a specimen dredged by the *Siboga* at station 99. It was redescribed and figured in my report on the unstalked crinoids of the *Siboga* expedition published in 1918, when notes were given on another specimen from the type locality, and also on one from *Albatross* station 5139.

In 1927 Dr. Torsten Gislén gave notes on a specimen in the Upsala Museum that he referred to *D. mylitta*. He did not, however, mention the locality from which it came. His mention of this specimen was incidental to his description of a specimen of *Oligometra japonica* collected by Dr. Th. Mortensen which he said it resembled rather closely, though the cirrus segments are somewhat shorter and the proximal pinnules are somewhat compressed and flagellate, and the outer segments are provided with spiny whorls at their distal ends.

DECAMETRA MOLLIS (A. H. Clark)

PLATE 24, FIGURE 122

[See also vol. 1, pt. 1, fig. 349 (cirrus), p. 291.]

Cyllometra mollis A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 76 (description; Kurrachi).

Decametra mollis A. H. CLARK, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 36 (compared with *D. mylitta*); Crinoids of the Indian Ocean, 1912, p. 161 (synonymy; detailed description; locality; notes), fig. 24, p. 162; Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 35 (Kurrachi; description); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 117 (in key; range), p. 120 (compared with *D. mylitta*); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, May 1929, p. 643 (Muhlos, Maldives); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 101 (range), p. 103.—MORTENSEN, Danish Scientific Investigations in Iran, pt. 2, 1940, p. 59 (Persian Gulf).—GISLÉN, *in* Mortensen, Danish Scientific Investigations in Iran, pt. 2, 1940, p. 111 (off Kharg Island; Stiffe's Bank).

Diagnostic features.—The cirri are 10 mm. long with 20–23 segments of which the five or six preceding the penultimate are almost or quite as long as broad; P_2 is the largest and longest pinnule with 14–17 segments of which the distal are twice as long as broad and the second and following have projecting outer corners or a few spines on the distal edge; the arms are 65 mm. long.

Description.—The centrodorsal is discoidal, thin, with the bare polar area flat, 2 mm. in diameter. The cirrus sockets are arranged in one and a more or less partial second crowded marginal rows.

The cirri are XX, 20–22, 10 mm. long. The first segment is short, the second and third are about twice as broad as long, and the remainder are very slightly broader than long, becoming almost as long as broad in the terminal five or six. The second and following segments have the distal dorsal edge produced and finely spinous, this projection progressively narrowing distally, at the same time very slowly moving to a more proximal position, after about the eighth becoming a pair of small subterminal tubercles which on the last five to seven segments give place to small median tubercles. The opposing spine is much larger than the spines on the preceding segments, in lateral view triangular with the apex terminal to almost median, in height reaching to one half or rather more of the width of the penultimate segment. The terminal claw is very slightly longer than the penultimate segment, moderately stout and moderately curved basally, becoming more slender and less curved distally.

The distal border of the radials is approximately on a level with the rim of the centrodorsal. The IBr_1 are oblong, about three times as broad as long, not in contact basally. The IBr_2 (axillaries) are pentagonal, about twice as broad as long, their lateral borders about half as long as those of the IBr_1 and making with them a very obtuse angle. The IBr series and lower brachials bear a slightly indicated median carination.

The 10 arms are 65 mm. long. The first two brachials are approximately equal, wedge-shaped, about twice as broad as their exterior length. The first syzygial pair (composed of brachials 3+4) is oblong, or slightly longer interiorly than exteriorly, from half again to twice as broad as long. The next four or five brachials are oblong, about three times as broad as long, those following becoming very obliquely wedge-shaped, almost triangular, half again as broad as long, in the distal portion of the arm less obliquely wedge-shaped and somewhat longer, and in the terminal portion longer than broad.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 14+15, and distally at intervals of from 4 to 8 (usually 6 or 7) muscular articulations. The second syzygy is occasionally between brachials 5+6, and the third may be as far out as between brachials 16+17.

P_a is absent. P_1 is small and weak, 4 mm. long, with 14 segments of which the first is short, the second is squarish, and those following gradually increase in length, becoming twice as long as broad distally; the segments in the distal third have the distal edge armed with fine spines. P_2 is 13 mm. long, stouter than P_1 though of the same proportions, with 17 segments which become about as long as broad on the third and twice as long as broad terminally; the second and following segments have a few spines on the distal edge. P_3 is 6 mm. long, basally as stout as P_2 but not tapering so rapidly and therefore less delicate distally, with 15 segments of which the distal are elongated. P_4 is 4 mm. long, not so delicate as P_1, with 10 segments. P_6 is 3 mm. long. The pinnules following increase slowly in length, the distal pinnules being 7 mm. long with elongated segments.

The color in alcohol is brown, the perisome darker.

Notes.—In the 6 specimens from Kurrachi in the British Museum the cirri are XII–XV, 20–23 (usually 22), 10 mm. long. The dorsal processes on the outer segments are very small. The 10 arms are 65 mm. long. P_1 has about 13 segments and resembles P_2, but is usually about 1 mm. shorter and proportionately more slender. P_2 is the largest pinnule, about 5 mm. long; it is slender, and most of its segments are about twice as long as broad, or even longer; the segments number about 14 of which those in the distal half are more or less prismatic and have projecting outer corners. P_3 is very similar to P_1. P_4 is shorter, and P_5 is shorter still. Sometimes P_1 is considerably shorter than P_2 or than P_3.

Localities.—Investigator; ?Kurrachi [A. H. Clark, 1909, 1912, 1918] (6, I. M.).

Kurrachi [A. H. Clark, 1913] (6, B. M.).

Persian Gulf, off Kharg Island, 12.5 meters; sand and stones; Dr. G. Thorson, March 16, 1937 [Mortensen, 1940; Gislén, 1940].

Persian Gulf; Stiffe's Bank; 33 meters; shells and coral sand; Dr. G. Thorson, April 7, 1937 [Mortensen, 1940; Gislén, 1940]

Muhlos, Maldive Islands; Prof. J. Stanley Gardiner [A. H. Clark, 1929] (4, B. M.).

Geographical range.—From Kurrachi and the Persian Gulf southward to the Maldive Islands.

Bathymetrical range.—From the shore line down to 33 meters.

History.—This species was originally described by me in 1909 under the name *Cyllometra mollis* from six specimens that had been collected by the Royal Indian Marine Surveying steamer *Investigator* probably at Kurrachi. It was redescribed and figured under the name *Decametra mollis* in my memoir on the crinoids of the Indian Ocean published in 1912. In 1913 I recorded and gave notes upon six specimens from Kurrachi that I had studied in the British Museum in 1910. In 1918 *mollis* was included in the key to the species of the genus *Decametra* in my report on the unstalked crinoids of the *Siboga* expedition. In 1929 I recorded four additional specimens in the British Museum that had been collected by Prof. J. Stanley Gardiner at Muhlos in the Maldive Archipelago.

In 1940 Prof. Torsten Gislén recorded one specimen from off Kharg Island and 50 from Stiffe's Bank in the Persian Gulf that had been collected in 1937 by Dr. G. Thorson. He said that these specimens corresponded very closely to my descriptions written in 1909 and 1912.

DECAMETRA BREVICIRRA (A. H. Clark)

PLATE 25, FIGURE 128

Colobometra (*Prometra*) *brevicirra* A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 321 (description; ?India; compared with *C.* [*P.*] *chadwicki* and with *C.* [*P.*] *owstoni*, and with *Oligometra serripinna*).

Prometra brevicirra A. H. CLARK, Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 269 (?India).

Decametra brevicirra A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 118 (in key; range).

Diagnostic features.—The cirri are 8 mm. long with 21–23 segments which become nearly or quite as long as broad on the antepenultimate; P_2 is 6 mm. long with 12 or 13 segments and is not much longer than P_1, which has the same number of segments; the outer segments bear spines at the prismatic angles; P_3 is only about half as long as P_2 and is smooth; the arms are about 35 mm. long.

Description.—The centrodorsal is broad and flat, with the cirrus sockets arranged in a single marginal row.

The cirri are XIV, 21–23 (usually the latter), 8 mm. long. The majority of the cirrus segments are about twice as broad as long, but in the distal half of the cirri the segments very slowly increase in length so that the antepenultimate is nearly or quite as long as broad. The earlier segments have the distal edge thickened on the dorsal side. On the fifth this production of the distal edge begins to divide, the lateral portions becoming swollen and a notch developing in the crest; on the ninth this interrupted transverse ridge has resolved itself into 2 very small and very sharp tubercles situated side by side which on the fifth segment preceding the penultimate themselves give place to single median dorsal spines. At all points these dorsal processes are practically median; they are exceedingly minute and very sharp.

The radials project very slightly beyond the rim of the centrodorsal; their anterolateral angles are slightly separated so that the bases of adjacent IBr_1 are not in contact. The IBr_1 are short, oblong, nearly 4 times as broad as long, with a low, though distinct, broad rounded median carination. The IBr_2 (axillaries) are broadly pentagonal, half again as broad as long, their lateral edges as long as those of the IBr_1 and making with them a broadly obtuse angle; in their proximal two-thirds they bear a broad rounded median carination similar to that on the IBr_1.

The 10 arms are about 35 mm. long. The proximal oblong brachials have a slight trace of a rounded median carination.

P_1 is 4.5 mm. long, evenly tapering to a delicate tip, somewhat stiffened, rounded prismatic, with 13 segments of which the first 2 are short, the third is slightly longer than broad, the fourth is half again as long as broad, and those following slowly increase in length so that the distal are about twice as long as broad. Beginning on the third segment very small but very sharp spines are developed on the distal ventral angles and in the middorsal portion of each segment. P_2 is 6 mm. long with 12 or 13 segments, resembling P_1 but larger, stouter, and stiffer with slightly longer spines at the distal prismatic angles of the segments. P_3 is 3 mm. long, more slender than P_1 though essentially similar to it but without the spines on the distal edges of the segments; it is slightly stiffened. P_4 and the following pinnules are slightly shorter than P_3, and apparently are not stiffened, at least distally. The distal pinnules are slender, 5 mm. long with 15 much elongated segments.

Localities.—*Investigator;* ?India (probably Ceylon) [A. H. Clark, 1912, 1918] (1, I. M.).

Investigator; ?India (probably Ceylon) [A. H. Clark, 1912] (1, I. M.).

Investigator; 1 mile east of the Terribles, a line of rocks from 10 to 12 miles west of the west point of Ramree Island, on the coast of Arrakan, Burma (lat. 19°27′ N., long 93°18′ E.); 24 meters (1, U. S. N. M., 35370).

Geographical range.—Definitely known only from the Arrakan coast of Burma; probably also occurs at Ceylon.

Bathymetrical range.—The only definite record is 24 meters.

History.—This species was first recorded under the name *Prometra brevicirra* (*nomen nudum*) on the basis of a specimen from ?India in a paper by me on a small collection of crinoids from the Indian Ocean which was published in July 1912. It was first described under the name *Colobometra* (*Prometra*) *brevicirra* from another specimen from ?India in an appendix to my memoir on the crinoids of the Indian Ocean published on November 22, 1912.

In the original description it was said to be most closely related to *C.* (*P.*) *chadwicki,* with which it agrees in the relative proportions of its lower pinnules, though these are as a whole much shorter. It is a smaller form than *chadwicki* with proportionately shorter cirri which are composed of much shorter segments. P_2 is much less elongate than the same pinnule in *chadwicki,* and is more slender with fewer segments which do not become so elongate distally. In *C.* (*P.*) *brevicirra* the cirri, though short, are one-third again as long as P_2, whereas in *C.* (*P.*) *chadwicki* P_2 and the cirri are of about the same length. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I included *brevicirra* in the key to the species of *Decametra,* giving as the habitat Ceylon and vicinity.

DECAMETRA PARVA (A. H. Clark)

PLATE 22, FIGURE 113

Prometra parva A. H. CLARK, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 39 (description; *Siboga* station 315).

Decametra parva A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery by the *Siboga* and its significance), p. 118 (in key; range), p. 121 (detailed description; stations 260, 315; also *Albatross* station 5557), pp. 275, 276 (listed), pl. 20, fig. 46.

Diagnostic features.—The cirri are about 5.5 mm. long with 14 or 15 segments of which the sixth or seventh and following are about as long as broad; P_2 is much larger and stouter than the other pinnules, though not greatly enlarged, with 11 segments; P_1, which is about two-thirds as long as P_2, also has 11 segments; P_3 is small and weak, much shorter than P_1; the arms are 40–45 mm. long.

Description.—The cirri are XIV, 14–15, 5.5 mm. long, resembling those of *D. minima;* the sixth or seventh and following segments are about as long as broad.

The 10 arms are about 40 mm. long. The lower oblong brachials are smooth, but those following have rather strongly everted distal ends.

P_1 is 2.3 mm. long, tapering rather rapidly in the first four segments and more gradually from that point onward, composed of 11 segments of which the first is short, the second is slightly longer, the third is slightly broader than long, the fourth is slightly longer than broad, and the fifth and following are about twice as long as broad. P_2 is from 3.5 to 4.5 mm. long, evenly tapering, much larger and stouter than the other pinnules though not greatly enlarged, with 11 segments of which the first is short, the second is half again as broad as long, the third is slightly broader than long, and those following gradually increase in length to the seventh which, with those succeeding, is twice as long as broad; the pinnule is rather strongly prismatic and the fourth and following segments have their distal edges produced at the prismatic angles into prominent short stout spines which increase in prominence distally. P_3 is 1.5 mm. long, small and weak, composed of 8 segments of which the distal are elongated. P_4 is slightly smaller than P_3. The distal pinnules are exceedingly slender, from 4 to 4.5 mm. long, with 13 segments of which the second and third are slightly carinate and the outer are greatly elongated.

Notes.—The specimen from off the Goto Islands seems to agree in all particulars with others from farther south.

The specimen from Port Galera, Mindoro, has the arms 45 mm. long.

In one of the specimen from the Danish Expedition to the Kei Islands station 101 the arms are 43 mm. long, the cirri have 14 or 15 segments, and P_2 has 11 segments.

Localities.—Off the Goto Islands, Korean Straits (lat. 33°10′05″ N., long. 129°18′07″ E.); 77 meters; Capt. H. Christiansen, SS. *Nordiske*, Arpil 9, 1913 (1).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; Port Galera, Mindoro; about 9 meters; February 3, 1914 (1).

Albatross station 5557; in the vicinity of Jolo (Sulu), Philippines; Cabalian Point bearing N. 70° W., 5.2 miles distant lat. 5°51′30″ N., long. 121°01′00″ E.); 24 meters; sand and coral; September 17, 1909 [A. H. Clark, 1918] (2, U. S. N. M., 36022).

Siboga station 260; 2.3 miles N. 63° W. from the northern point of Nuhu Jaan, Kei Islands (lat. 5°36′30″ S., long. 132°55′12″ E.); 90 meters; sand, coral, and shells; December 16–18, 1899 [A. H. Clark, 1918] (2, U. S. N. M., E. 453; Amsterdam Mus.).

Siboga station 315; anchorage east of Sailus Besar, Paternoster Islands; down to 36 meters; January 17–18, 1900 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 101; Java Sea; 49 meters; sand, stones, and sponges; August 5, 1922 (7).

Geographical range.—From southwestern Japan southward to the Kei Islands, and westward to the Java Sea.

Bathymetrical range.—From 9 to 90 meters.

History.—This species was first described under the name *Prometra parva* by me in 1912 from a single specimen dredged by the *Siboga* at station 315. In 1918 it was redescribed and figured under the name *Decametra parva*, and additional specimens were recorded from *Siboga* station 260 and from *Albatross* station 5557.

DECAMETRA MINIMA (A. H. Clark)

PLATE 25, FIGURE 131

Prometra minima A. H. CLARK, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 38 (description; *Siboga* station 117).

Decametra minima A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery by the *Siboga* and its significance), p. 118 (in key; range), p. 121 (detailed description; stations 79*a*, 117, 144, 260; also *Albatross* station 5248), pp. 272, 273, 275 (listed), pl. 20, fig. 45.

Diagnostic features.—The cirri are X, 10–12, 3–4 mm. long, with the fifth or sixth and following segments about as long as broad; P_2 is 3 mm. long with 8 or 9 segments, stiff and spinelike, though slender; P_1 is 2 mm. long with 8 or 9 segments; P_3 is small and slender, with 8 segments; the arms are 35–40 mm. long and very slender.

Description.—The centrodorsal is thin discoidal with the dorsal pole flat and finely papillose, 1 mm. in diameter.

The cirri are X (rarely any other number), 10–12, from 3 to 4 mm. long. The first segment is short and those following increase in length to the fifth or sixth which, with the succeeding, is about as long as broad. The second and following have a finely serrate transverse ridge which becomes median in position after the fourth or fifth, low and very narrow, appearing as a very minute sharp spine in lateral view. On the second-fourth segments the lateral angles of this ridge project beyond the borders of the cirrus segments as viewed dorsally, but from that point onward it becomes narrower, beyond the sixth dividing more or less completely into two transversely oblong sharp ridges or small sharp spines. The antepenultimate segment bears a single spine. The opposing spine is much larger than the spine on the segment preceding.

The radials are just visible beyond the rim of the centrodorsal. The IBr_1 are very short, about four times as broad as long, with the proximal and distal edges straight and parallel and the lateral edges converging slightly; there are slight rounded ventrolateral projections. The IBr_2 (axillaries) are broadly pentagonal, half again as broad as long. Synarthrial tubercles are moderately developed. Like the IBr_1, the IBr_2 and first brachials have slight rounded ventrolateral processes.

The 10 arms are from 35 to 40 mm. long and very slender, resembling those of the other species of the genus. On the lower oblong brachials there is a faintly indicated rounded median carination.

P_1 is 2 mm. long, nearly as stout basally as P_2, but tapering more rapidly and becoming slender and delicate distally, composed of 8 or 9 segments of which the first is short, those following gradually increasing in length and becoming slightly longer than broad on the third and about twice as long as broad distally; the distal edges of the outer segments are slightly spinous. P_2 is 3 mm. long, stiff and spinelike though slender, tapering slowly from the base to the tip, composed of 8 or 9 segments of which the first is twice as broad as long, the second is nearly as long as broad, the third is nearly twice as long as broad, and the remainder are about three times as long as broad; the third and following bear long and prominent spines at the prismatic angles; the pinnule is rather strongly prismatic. P_3 is 2 mm. long, small and slender, slightly stiffened, composed of 8 segments which become elongated distally. P_4 is 1.25 mm. long, very delicate and not stiffened, composed of 9 segments which become much elongated distally. P_5 is similar to P_4 but slightly shorter. The distal pinnules are 2.5 mm. long, exceedingly slender and delicate, composed of 13 segments of which the second and third are strongly carinate and the outer are very greatly elongated.

The disk is thickly sprinkled, or almost covered, with small rounded plates.

Notes.—Some specimens show a much greater development of the spines on the lower segments of the pinnules than others.

The specimen from *Siboga* station 79*a* has the arms about 15 mm. long, and 11 or 12 cirrus segments. The specimen from *Siboga* station 144 has the arms about 20 mm. long. The specimen from *Siboga* station 260 has the arms 18 mm. long and the cirri with 11 segments.

Localities.—*Albatross* station 5248; Gulf of Davao, Philippine Islands; Lanang Point bearing S. 33° W., 0.4 miles distant (lat. 7°07′25″ N., long. 125°40′24″ E.); 33 meters; coral; May 18, 1908 [A. H. Clark, 1918] (1, U.S.N.M., 36038).

Siboga station 79*a*; Borneo Bank (lat. 2°38′30″ S., long. 117°46′00″ E.); 54 meters; fine coral sand; June 12, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 117; entrance to Kwandang Bay, Celebes (lat. 1°00′30″ N., long. 122°56′00″ E.); 80 meters; sand and coral; July 12, 1899 [A. H. Clark, 1912, 1918] (24, U.S.N.M., E. 406; Amsterdam Mus.).

Siboga station 260; 2.3 miles N. 63° W. from the northern point of Nuhu Jaan, Kei Islands (lat. 5°36′30″ S., long. 132°55′12″ E.); 90 meters; December 16–18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 144; anchorage north of Salomakiëe (Damar) Island; 45 meters; coral and lithothamnion; August 7–9, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From the Philippine Islands to Celebes, Borneo Bank, the Kei Islands, and Salomakiëe (Damar) Island.

Bathymetrical range.—From 33 to 90 meters.

History.—This species was first described by me in 1912 under the name *Prometra minima* from 24 specimens that had been dredged by the *Siboga* at station 117. It was redescribed and figured in 1918, when additional specimens were recorded from *Siboga* stations 79*a*, 144, and 260, and *Albatross* station 5248.

DECAMETRA LAEVIPINNA (A. H. Clark)

PLATE 22, FIGURE 109; PLATE 25, FIGURES 129, 132

?*Antedon sinensis* HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (listed), p. 378 (detailed description; Hong Kong), pl. 13, fig. 4.

Prometra laevipinna A. H. CLARK, Ann. Mag. Nat. Hist., ser. 8, vol. 10, 1912, p. 37 (description; Salayer).

?*Amphimetra sinensis* A. H. Clark, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in east Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 90 (references; notes; identity doubtful).

Decametra laevipinna A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery by the *Siboga* and its significance), p. 118 (in key; range), p. 120 (detailed description; station 213). p. 274 (listed), pl. 20, figs. 42, 43; Temminckia, vol. 1, 1936, p. 295 (listed), p. 308 (Obi latoe, Sipankot; Boo Islands; notes), pl. 8, fig. 7.

Diagnostic features.—The cirri are 10–15 mm. long with 18–25 (usually 23–25) segments mostly about as long as broad, all but the basal with a transverse ridge dorsally; P_2 is 6.5–7.8 mm. long, longer than P_1, with 17–19 segments and perfectly smooth; P_3 is similar to P_2 with an equal number of, or fewer, segments, but shorter; the arms are 40–50+ mm. long.

Description.—The centrodorsal is discoidal with a broad, flat, circular dorsal pole 2 mm. in diameter. The cirrus sockets are arranged in a single closely crowded marginal row.

The cirri are XIV, 18–23, 13 mm. long. The first segment is very short, those following gradually increasing in length and after the tenth or eleventh being about as long as broad. The first segment has the distal dorsal edge produced; on the second and third this production becomes a strong transverse ridge that gradually moves anteriorly, becoming median on the eighth and following where it appears as a minute median spine in lateral view. This ridge shows no tendency to resolve itself into paired spines or tubercles, nor does it narrow appreciably on the outer segments, occurring as a broad transverse ridge even on the antepenultimate. The opposing spine is small, slender, median, and erect, in height about equal to one-fourth the width of the penultimate segment.

The arms resemble those of the other species of the genus, and are about 50 mm. long.

P_1 is 5.5 mm. long, moderately slender, somewhat stiffened, with 14 or 15 segments of which the first is short and those following gradually increase in length becoming about as long as broad on the fifth and on the outer very slightly longer than broad; from the third segment outward the pinnule is rather strongly prismatic with a prominent rounded ridge running along the center of the outer surface. P_2 is 6.5 mm. long with 17 segments, resembling P_1 but slightly more slender basally and tapering more evenly to the tip, and not so strongly prismatic; the distal edges of the segments of both these pinnules are perfectly smooth. P_3 is 4.5 mm. long with 14 segments, similar to P_2 but proportionately smaller and more slender distally. P_4 is 3.5 mm. long with 13 segments, small and slender. P_5 is similar, 3 mm. long, with 11 segments. P_6 is similar to P_5, 3 mm. long with 12 segments. The distal pinnules are very slender, 7 mm. long with 20–22 segments.

Notes.—The specimen from Hong Kong probably representing this species was thus described by Hartlaub:

The centrodorsal is flat discoidal with marginal cirri. The cirri are about XVI, about 25, about 10 mm. long, and rather slender. The cirrus segments are very uniformly short. In the distal half of the cirri the distal ends of the segments dorsally are somewhat produced so that the cirri here have a bluntly serrate dorsal profile. The opposing spine is well developed. The radials are scarcely visible.

The IBr_1 are short, with the sides rounded off and laterally free. The pentagonal IBr_2 (axillaries) are likewise short, and form with the IBr_1 a buttonlike synarthrial tubercle. The 10 arms are about 40 mm. long. The first brachials are short discoidal, as long interiorly as exteriorly, and are more or less united interiorly. The second brachials are slightly larger than the first, and on the tubercular articulation between them there is a little button. Both the first and the second brachials are markedly broader than those succeeding. The first syzygial pair (composed of brachials 3+4) is not longer than the second bracial. Then follows a series of shorter discoidal brachials which at about the eleventh pass over into short triangular brachials of which the everted distal ends overlap the bases of those following. Each of the discoidal brachials following the first syzygial pair has on the distal edge in the mid-dorsal line a whitish buttonlike elevation which from the first syzygial pair or the fifth brachial onward is very prominent. The distal brachials remain short, and toward the arm tip become more cylindrical. Syzygies occur between brachials 3+4, 9+10, 18+19, 23+24, and 30+31; or between brachials 3+4 and 15+16; or between brachials 8+9, 13+14, 17+18, 21+22, and 26+27; or between brachials 8+9, 16+17, 23+24, and 30+31. The syzygies are very variable in their position. On one arm there is a syzygy between brachials 5+6 as well as between brachials 3+4. P_1 is apparently moderately short and stout with about 12–15 segments; but none of the P_1 are preserved entire. The lower segments of this and the three following pinnules, with the exception of the basal, are carinate. P_2 is obviously of about the same size. It is composed of 16 segments of which the distal are elongated. At the base P_1 and P_2 are equally stout. The stoutness decreases very rapidly distally. On the following three markedly weaker pinnules there are traces of carination on the basal segments. The state of preservation is very poor. Apparently P_3 or P_c are the shortest pinnules. P_4 is already longer again. All the pinnules are somewhat weak with the exception of the somewhat stiff first. P_a is somewhat weaker than P_1, but is in no case preserved entire. None of the proximal pinnules are remarkable for any special elongation, and none of them are flagellate. The color in alcohol is dark brown with the centrodorsal and cirri very much lighter, the last almost white. The pinnules and the buttonlike tubercles on the earlier brachials are light brown. Also on the dorsal surface of the brachials there is a larger light brown elevation. The perisome is dark brown.

The specimen from Obi latoe may be described as follows: The centrodorsal is discoidal with the dorsal pole concave, 2 mm. in diameter, and the sides slightly convergent. The cirrus sockets are arranged in a single closely crowded marginal row. The cirrus sockets are oblong with rounded angles, and are twice as high as broad or even higher. The cirri are XV, 23–24, 15 mm. long. The first segment is very short, and those following slowly increase in length so that the last 8 to 10 are about as long as broad. The third and following segments have a finely serrate transverse ridge which on the fifth-ninth is evenly bowed proximally, then becomes straighter, and on about the twelfth becomes median, straight, with the crest convex in end view. Farther out it becomes gradually narrower and lower, and on the antepenultimate segment is represented by a short transverse ridge situated proximal to the middle of the segment. The opposing spine is small, slender, sharp, median, and erect, rising to a height equal to less than half the width of the penultimate segment. The cirri in dorsal view are much compressed basally, increasing in width to the third or fourth segments, which are about twice as broad as the first segment, then tapering gradually for about three segments, after which they remain of practically uniform width. The first three segments are sharply flattened laterally. P_1 is 7.5 mm. long with 18 segments of which the first is more than twice as broad as long, the second is somewhat longer than broad, the third is about as long as broad, and the remainder are slightly longer than broad. The pinnule is perfectly smooth. P_2 is 7.8 mm. long with 18 or 19 segments, resembling P_1 but slightly stouter and stiffer. P_3 is 6 mm. long with 16–19 segments, resembling P_1 but slightly stouter in the outer portion. The pinnules following are small and weak. P_a is absent. Except for being much larger, this specimen very closely resembles the type.

One of the three specimens from Sipankot has the arms 50 mm. long; the cirri are X, 18–20, 8 mm. long; P_1 has 14 segments P_2 has 18 segments. The other two are smaller. These very closely resemble *D. informis*, but are distinguished by the smooth P_2, which has more numerous segments.

The specimen from the Boo Islands is small.

Localities.—*Siboga* station 213; Island of Salayer, south of Celebes; reef; October 26, 1899 [A. H. Clark, 1912, 1915, 1918] (1, Amsterdam Mus.).

?Hong Kong; United States North Pacific Exploring Expedition; according to Hartlaub this specimen is M. C. Z., 2698; in addition to this number he found No. 25 on a bit of paper in the jar with it, and No. 90 on the jar itself.

Obi latoe; shore and reef; *Willebrord Snellius*, April 23–27, 1930 [A. H. Clark, 1936] (1, L. M.).

Sipankot, near Sibutu, Sulu (Jolo) Archipelago; 3–6 meters; *Willebrord Snellius*, September 10–14, 1929 [A. H. Clark, 1936] (3, L. M.).

Boo Islands; *Willebrord Snellius*, October 5, 1930 [A. H. Clark, 1936] (1, L. M.).

Geographical range.—From Salayer, south of Celebes, and Obi latoe, south of Halmahera (Gilolo), northward to the Sulu (Jolo) Archipelago and ?Hong Kong.

Bathymetrical range.—From the shore line down to 3 (?6) meters.

History.—Hartlaub's *Antedon sinensis*, described in April 1912 from a specimen from Hong Kong, is probably this species. The species was described by me as *Prometra laevipinna* in July 1912 from a single specimen that had been collected by the *Siboga* at Salayer. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 it was redescribed in detail and figured. In my report on the unstalked crinoids of the *Willebrord Snellius* expedition published in 1936 I recorded and gave notes on one specimen from Obi latoe and three from Sipankot, and recorded a fifth from the Boo Islands.

DECAMETRA STUDERI (A. H. Clark)

Plate 24, Figure 121

Oligometra studeri A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 41 (description; Dirk Hartog Island, 7 fms.), p. 88 (should have been referred to *Cyllometra*); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 437 (history; belongs in *Decametra*), p. 443 (range); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (belongs in *Decametra*).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 237 (No. 6381).

Cyllometra studeri A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 88 (*studeri* correctly placed); Zool. Anz., vol. 34, No. 11/12, 1909, p. 368 (Dirk Hartog Island, 7 fms.); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 31 (arms compared with those of *Decametra möbiusi*).

Decametra studeri A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 441 (Australian tropical species occurring south to Dirk Hartog Island), p. 446 (summary of west Australian records); Mem. Australian Mus., vol. 4, 1911, p. 724 (locality), p. 774 (synonymy; characters; Australian record); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (=*Oligometra studeri*), p. 400 (locality); Crinoids of the Indian Ocean, 1912, p. 164 (synonymy; locality); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of the distribution in Australia).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 235 (Dirk Hartog Island; No. 6381).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 118 (in key; range).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52.

Diagnostic features.—The cirri are 7 mm. long with 16–18 segments of which the sixth or seventh and following are about as long as broad and the four to six preceding the penultimate bear a single median dorsal tubercle or short spine; P_2 is the largest and longest pinnule, 6 mm. long with 18 segments; P_3 is shorter than P_1; the arms are 45 mm. long.

Description.—The centrodorsal is thin discoidal, with the bare polar area flat. The cirrus sockets are arranged in a single marginal row.

The cirri are XII, 16–18, 7 mm. long. The first segment is very short, the following gradually increasing in length to the sixth or seventh which, with the remainder, is about as long as broad. On the third or fourth segment a low transverse ridge is developed on the dorsal side which is subterminal in position. This gradually moves proximally, after 3 or 4 segments attaining a median position, at the same time gaining slightly in height; distally it progressively decreases in width, and on the last 4 segments before the penultimate becomes a low median spine. The ridges on all the segments appear as low spines in lateral view. The opposing spine is median in position, and arises from the entire dorsal surface of the penultimate segment. It is much higher than the short processes on the preceding segments, its height equaling about half the width of the penultimate segment. The terminal claw is rather stout, slightly longer than the penultimate segment, abruptly curved basally but becoming more nearly straight distally.

The radials are concealed by the centrodorsal in the midradial line, but are visible in the interradial angles of the calyx. The IBr_1 are oblong, short, about 4 times as broad as long, with the lateral edges straight. The IBr_2 (axillaries) are broadly pentagonal, almost triangular, about twice as broad as long. Synarthrial tubercles are slightly developed.

The 10 arms are 45 mm. long. The first 2 brachials are wedge-shaped, slightly over twice as broad as the exterior length, the first interiorly united for rather more than the proximal half, diverging at an obtuse angle distally. The first syzygial pair (composed of brachials 3+4) is slightly longer interiorly than exteriorly, about twice as broad as the median length. The following 3 brachials are oblong, about 3 times as broad as long, the brachials then becoming obliquely wedge-shaped and after the twelfth triangular, slightly broader than long, and in the terminal portion of the arm wedge-shaped and about as long as broad. After the tenth the brachials develop rather prominent and slightly overlapping distal ends, but this feature gradually dies away after about the middle of the arms.

Syzygies occur between brachials 3+4, 9+10 (sometimes omitted), and 14+15, and distally at intervals of 4–7 (usually 5) muscular articulations.

P_a is absent. P_1 is about 4.5 mm. long, slender, evenly tapering and becoming flagellate in the distal portion, with about 16 segments of which the first 2 are rather over twice as broad as long, the third is nearly as long as broad, and the following increase in length, being about twice as long as broad distally. P_2 is 6 mm. long, the largest and longest pinnule on the arm, with about 18 segments of which the first 2 are approximately twice as broad as long, the third is about as long as broad, and the remainder are about half again as long as broad. The pinnule is smooth, the segments being without lateral processes or everted ends. P_3 is 3 mm. long, small and weak, nearly as large basally as P_1 but tapering more rapidly, with 13 segments of which the first is short, the following increase in length to the fourth, which is about as long as broad, and further increase to a length of about twice the breadth in the terminal portion. The following pinnules are similar, soon becoming more slender and gradually increasing in length. The distal pinnules are very slender and hairlike, about 7 mm. long with 23 segments of which the first is short and crescentic, the second is nearly as long as broad, slightly less in width distally than proximally, the third is squarish, and the remainder are about half again as long as broad, becoming about twice as long as broad in the distal portion.

The color in alcohol is brownish purple with the cirri and the dorsal surface lighter.

Locality.—Gazelle; Dirk Hartog Island, Western Australia; 13 meters [A. H. Clark, 1909, 1911, 1912, 1915, 1916, 1918; Hartmeyer, 1916] (1, Berl. M., 6381).

History.—This species was originally described by me on March 10, 1909, under the name *Oligometra studeri* from a single specimen in the Berlin Museum (Cat. No. 2964 [part]) that had been collected by the *Gazelle* at Dirk Hartog Island, Western Australia, in 7 fathoms. I said that this new form is readily distinguishable from the ten previously described species of the genus [*Oligometra*]; the elongate P_1 of *O. bidens*, as well as the two dorsal processes on its cirrus segments, the very numerous cirrus segments of *O. gracilicirra*, the short stout cirrus segments of *O. pinniformis*, the single dorsal spine on the few stout cirrus segments of *O. caribbea*, the strong imbrication of the brachials of *O. imbricata*, and the spines or lateral processes on the proximal pinnules of *O. gracilicirra*, *O. carpenteri*, *O. japonica*, *O. pulchella*, and *O. serripinna* separate them at once. The elongate proximal pinnules described in *O. adeonae* would serve to differentiate it, if *adeonae* should be shown to really belong to the genus *Oligometra*. *Oligometra studeri* is most closely related to the group of species typified by *O. serripinna*.

On April 17, 1909, I wrote that by an unfortunate slip I had described a new comatulid from Dirk Hartog Island under the name *Oligometra studeri*, whereas it belongs in reality to the genus *Cyllometra* and should have been called *Cyllometra studeri*. *Cyllometra studeri* is related to *C. informis* which was taken by the *Challenger* among the Philippine Islands in 18 fathoms. *Cyllometra studeri* differs from *C. informis* most obviously in its smooth pinnules, the lower and middle pinnules in the latter having slightly overlapping and spinous ends to the segments, and in the much greater length and greater slenderness of P_2, which is twice as long as P_3 and is composed of 18 segments most of which are elongated, instead of only slightly when at all longer than P_3 with 12 segments most of which are about as long as broad. Both species are readily distinguished from the others of the genus (*Cyllometra*) by the small number of cirrus segments.

In a paper on the crinoids of the *Gazelle* expedition published on June 1, 1909, *Cyllometra studeri* was briefly recorded without comment. In a paper on the crinoids of the coasts of Africa published in 1911 I compared the arms of *C. studeri* with those of the new species *Decametra möbiusi*. Later in 1911 I mentioned *Decametra studeri* in my report upon the crinoids of the Hamburg Southwest Australian Expedition, and also in my memoir on the crinoids of Australia. In my paper on the crinoids of the Berlin Museum published in 1912 I listed *Decametra studeri*, giving the locality and a reference to the paper on the crinoids collected by the *Gazelle*. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Decametra studeri* and gave its synonymy and range. The range of *D. studeri* was considered in detail in a paper on the distribution of crinoids on the coasts of Australia published by the author in 1915.

Dr. Robert Hartmeyer in 1916 published a note on *Decametra studeri*, giving the catalog number, 6381, of the type specimen in the Berlin Museum.

In my report upon the crinoids of the *Siboga* expedition published in 1918 I included *studeri* in the key to the species of *Decametra* and gave the range.

DECAMETRA INFORMIS (P. H. Carpenter)

Plate 24, Figure 125

Antedon informis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 205 (description; *Challenger* station 208), pl. 33, fig. 3.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 42 (compared with *A.* [*Petasometra*] *clarae*).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (=*Decametra informis*).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52.

Cyllometra informis A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed), p. 77 (arms compared with those of *C.* [*Decametra*] *mollis*), p. 88 (compared with *C.* [*Decametra*] *studeri*; north end of Samal Island, Philippines, 23 fms.).

Decametra informis A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 32 (arms compared with those of *D. modica*); vol. 43, 1912, p. 400 (Singapore; description); Crinoids of the Indian Ocean, 1912, p. 33 (identity) p. 164 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 34 (published reference to the specimen in the B. M.; *Challenger* station 208); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 118 (in key; range), p. 123 (*Albatross* station 5249); Temminckia, vol. 1, 1936, p. 309 (Sipankot; notes), pl. 8, fig. 8.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 52.

Diagnostic features.—The cirri are 7 mm. long with 14–18 segments; P_1 and P_2 have 10–12 segments, the outermost with small tufts of spines on the distal edge; P_2 is longer and stouter than P_1; the arms are 30–40 mm. long.

Description.—The centrodorsal is discoidal with a smooth dorsal surface and marginal cirri.

The cirri are about XII, 15–18. The segments are as broad as or broader than long, most of them with a slight elevation in the middle of the dorsal edge. The penultimate segment has a faint opposing spine.

The radials are partially visible. The IBr_1 are oblong with a rounded dorsal surface and are but slightly united laterally. The IBr_2 (axillaries) are also rounded, short, and widely rhombic.

The 10 arms are perhaps 40 mm. long. The first few brachials are nearly oblong and those following are rather broader than long, somewhat overlapping, and almost triangular, gradually becoming obliquely quadrate.

The first syzygy is between brachials 3+4, the next usually about brachials 12+13 or 13+14, and the distal intersyzygial interval is from 4 to 6 muscular articulations.

P_1 is comparatively small and consists of about 12 squarish segments. P_a is usually absent; if present it is similar to P_1 but smaller. P_2 is considerably longer and stouter, but the pinnules following are smaller again.

Sacculi are very abundant on both arms and pinnules.

The color in alcohol is white.

The preceding description is adapted from the original description by Carpenter. In Carpenter's figure most of the cirrus segments are shown as nearly or quite as long as broad with a median low transverse ridge. P_1 is 2.7 mm. long. P_2 is 3 mm. long with 11 or 12 segments.

Notes.—The specimen from Singapore is small with the arms about 20 mm. long. In this small specimen P_2 is composed of longer segments than it is in the fully grown, and P_3 is proportionately shorter. The number of segments in P_2, however, is the same as in fully grown *D. informis*, and they have the same overlapping and spinous distal edges.

The specimen from Sipankot has the arms about 30 mm. long. The cirri are 7 mm. long with 14 or 15 segments. P_2 has 10 or 11 segments, the outermost with a small tuft of spines on the distal edge on the side toward the arm tip.

Localities.—*Challenger* station 208, off Luzon, Philippine Islands (lat. 11°37′ N., long. 123°31′ E.), 33 meters; blue mud; January 17, 1875 [P. H. Carpenter, 1888; Hartlaub, 1891; A. H. Clark, 1907, 1909, 1912, 1913] (1, B. M.).

Albatross station 5249; Gulf of Davao, Philippine Islands; Lanang Point bearing N. 1 mile distant (lat. 7°06′06″ N., long. 125°40′08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909, 1912, 1918] (1, U. S. N. M., 35283).

Albatross station 5557, in the vicinity of Jolo (Sulu), Philippine Islands; Cabalian Point bearing N. 70° W., 5.2 miles distant (lat. 5°51′30″ N., long. 121°01′00″ E.); 24 meters; sand and coral; September 18, 1909 (2, U. S. N. M., 36022).

Sipankot, near Sibutu, Sulu (Jolo); 3–6 meters; *Willebrord Snellius*, September 10–14, 1929 [A. H. Clark, 1936] (1, L. M.).

Singapore; Prof. Edouard von Martens [A. H. Clark, 1912] (1, Berl. M., 5353).

Geographical range.—From the Philippine Islands to Singapore.

Bathymetrical range.—From shallow water down to 42 meters.

History.—This species was described by Dr. P. H. Carpenter in 1888 from a single imperfect specimen that had been dredged by the *Challenger* at station 208 under the name *Antedon informis*.

In 1891 Dr. Clemens Hartlaub mentioned the absence of P_a in *Antedon informis* in connection with the same feature in his new *A. clarae*.

In my first revision of the old genus *Antedon* published in 1907 I referred *informis* to my new genus *Cyllometra*, and also listed it under this genus in my revision of the family Himerometridae published on January 9, 1909. In a paper on new crinoids from the Indian Ocean published on April 17, 1909, I compared the arms of this species with those of my new species *Cyllometra mollis*, and in another paper published on the same date I compared *Cyllometra studeri* with *C. informis*, at the same time mentioning a second specimen of the latter in the United States National Museum from off the northern end of Samal Island, Philippines, in 23 fathoms (*Albatross* station 5249) that appears to be typical, agreeing perfectly with Carpenter's figure. In 1911 the arms of this species were compared by the author with those of a new species, *Decametra modica*. In a paper on the crinoids of the Berlin Museum published on November 20, 1912, I recorded a young specimen that had been collected at Singapore by Prof. Edouard von Martens and gave notes upon it. In my memoir on the crinoids of the Indian Ocean published on November 22, 1912, I listed *Decametra informis* and gave as the habitat the Philippine Islands and Singapore in 0–23 fathoms. In a paper on the crinoids of the British Museum published in 1913 I mentioned having seen the type specimen of *Antedon informis* in 1910 and noted that it had been well figured by Carpenter. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *informis* in the key to the species of *Decametra*, and also recorded a specimen from *Albatross* station 5249.

DECAMETRA MODICA A. H. Clark

PLATE 22, FIGURE 111; PLATE 25. FIGURES 126, 127

Antedon laevissima (part) BELL, *in* Gardiner, Fauna and geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 224 (Fadiffolu, Maldives).

Decametra modica A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast coast of Africa), p. 32 (description; Bagamoyo); vol. 43, 1912, p. 382 (cotype from Bagamoyo in the U. S. N. M.), p. 384 (original reference), p. 400 (locality); Crinoids of the Indian Ocean, 1912, p. 163 (synonymy; Bagamoyo).—HARTMEYER, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (Bagamoyo; No. 6382).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 118 (in key; range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 101 (range), p. 104.

Decametra möbiusi A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast coast of Africa), p. 31 (description; Mauritius); vol. 43, 1912, p. 384 (original reference), p. 400 (Mauritius); Crinoids of the Indian Ocean, 1912, p. 40 (=*Antedon laevissima*, part, Bell, 1902), p. 163 (synonymy; Mauritius; Muhlos and Fadiffolu, Maldives).—HARTMEYER, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (Mauritius; No. 4995).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 118, footnote (=*D. modica*); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 101 (synonym of *D. modica*).—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 52.

Decametra moebiusi A. H. CLARK, Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 269 (?India); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 36 (published references to specimens in the B. M.; Fadiffolu and Muhlos, Maldives; notes).—A. H. CLARK, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 101 (synonym of *D. modica*).

Diagnostic features.—The cirri are 7–8 mm. long with 14–20 segments that gradually increase in length to the terminal, which are about as long as broad; on the five or six preceding the penultimate there is a small very sharp median spine; P_1 and P_2 have 11–13 segments which have slightly projecting and finely spinous distal edges, P_2 is longer and somewhat stouter than P_1, 4.5 mm. long; P_3 is much smaller and weaker, though not much shorter, than P_1; the arms are 35–50 mm. long.

Description.—The centrodorsal is small, discoidal, with a very small dorsal pole. The cirrus sockets are arranged in two closely crowded irregular marginal rows.

The cirri are XIV–XVI, 16–20, 8 mm. long. The first segment is short, those following slowly increasing in length and becoming terminally about as long as broad. The third and following segments have slightly produced distal dorsal edges which on the segments succeeding gradually become narrower and move to a more central position, on the last five or six preceding the penultimate becoming a very small sharp median spine. The opposing spine is prominent, sharp, slender, subterminal, much larger than the spines on the preceding segments, directed obliquely forward, and in height equal to one-half the width of the penultimate segment.

The radials are short, about two and one-half times as broad as long. The IBr_1 are oblong, rather more than twice as broad as long. The IBr_2 are pentagonal, broader than long, with the distal edges slightly thickened.

The 10 arms are from 35 to 40 mm. long and resemble those of *D. informis*, though the brachials are slightly longer.

P_1 is 3.5 mm. long with 11 or 12 segments of which the first is short, the second is about as long as broad, and those following slowly increase in length, becoming three times as long as broad terminally. The pinnule is comparatively stout and resembles P_2, though, in direct proportion to its lesser length, it is smaller. P_2 is 4.5 mm. long with 13 segments of which the first is short, the second is about as long as broad, and those following gradually increase in length, becoming twice as long as broad distally. The third and following segments have slightly projecting and finely spinous distal edges, especially along the thin ventral distal border. P_3 is 3 mm. long, much smaller and weaker and much less stiff than P_1, with 10 segments. The pinnules following are similar, slowly becoming longer and more slender, and the component segments slowly increasing in length. The distal pinnules are very slender, 5 mm. long.

The color in alcohol is light pinkish, narrowly and sparsely banded with deep purple, or entirely deep purple.

The preceding description is based upon the three original specimens from Bagamoyo.

Notes.—The specimen from Mauritius was originally described as the representtative of a new species, *Decametra möbiusi*, in the following terms: The centrodorsal is small and thin discoidal. The cirrus sockets are arranged in a single somewhat irregular marginal row. The cirri are XIV, 14–16, 7 mm. long. The first segment is short and those following gradually increase in length to the sixth which, with those succeeding, is about as long as broad. On the fourth segment a slight projection of the distal dorsal edge begins to appear. This moves progressively anteriorly, on the ninth and following becoming a low, short transverse ridge appearing as a small spine in lateral view, and on the last two or three segments a small median spine. The opposing spine is median in position, slender and sharp, much longer than the processes on the segments preceding, in height equal to about half the width of the penultimate segment. The terminal claw is longer than the penultimate segment and is stout and comparatively slightly curved basally, but becomes more slender and more strongly curved in the distal half. The radials project slightly beyond the rim of the centrodorsal; their anterolateral angles are widely separated. The IBr_1 are oblong, about two and one-half times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, about twice as broad as long. The 10 arms are 50 mm. long and resemble those of *D. studeri*. P_1 is 4.5 mm. long, slender, evenly tapering, and becoming flagellate distally. It is composed of about 13 segments of which the first is short, the second and third are about as long as broad, and those following gradually increase in length, becoming about twice as long as broad distally, but shorter again terminally. P_2 is 5 mm. long, stouter and stiffer than P_1, and is the largest pinnule on the arm. It is composed of 11 or 12 segments of which the first is about twice as broad as long, the second is almost or quite as long as broad, and those following gradually increase in length, being twice as long as broad in the distal half of the pinnule. The distal edges of the second and following segments are slightly everted and finely spinous, and the dorsal distal angles are produced in the form of a short blunt process tipped with a tuft of fine spines. P_3 is 3 mm. long with about 12 segments proportioned as are those of P_2. The pinnule is slightly less stout basally than P_1, and is shorter, weaker, and more slender than that pinnule. The pinnules following are similar, soon gradually increasing in length and becoming more slender. The distal pinnules are about 6 mm. long, composed of about 18 much elongated segments, and exceedingly slender. The color in alcohol is light yellowish with the elements of the IBr series, a narrow band at the level of the second syzygy, and a few ill-defined bands in the distal portion of the arms, purple. The perisome is brown, and the cirri and P_2 are straw yellow.

The specimen from Fadiffolu, Maldives, has the arms 30 mm. long. The cirri have 15 segments. P_2 is slender, not greatly longer than P_1, and is composed of elongated segments with overlapping distal ends. P_1 is longer than P_3 and the following pinnules.

The three specimens from Muhlos, Maldives, have an arm length of from 55 to 60 mm. The cirri are XIV, 15, rather slender. P_1 is about two-thirds as long as P_2, and is much more slender and less stiffened. P_2 is long, but comparatively slender; it is composed of 12 segments of which the distal are twice as long as broad and have projecting distal edges. P_3 and the pinnules following are shorter than P_1.

Localities.—Bagamoyo, Tanganyika Territory (formerly German East Africa), 26 miles from Zanzibar (lat. 6° 27′ S., long. 38° 55′ E.) [A. H. Clark, 1911, 1912, 1918; Hartmeyer, 1916] (3, U. S. N. M., 35385; Berl. M., 6382 [4616]).

Mauritius; Prof. Karl Möbius [A. H. Clark, 1911, 1912, 1918] (1, Berl. M., 4995 [5349]).

Fadiffolu, Maldive Islands; Prof. J. Stanley Gardiner [Bell, 1902; A. H. Clark, 1912, 1913] (1, B. M.).

Muhlos, Maldive Islands [A. H. Clark, 1912, 1913] (3, B. M.).

Investigator; ?India (probably Ceylon) [A. H. Clark, 1912] (1, I. M.).

Geographical range.—From Bagamoyo and Mauritius to the Maldive Islands, and probably to Ceylon.

Bathymetrical range.—Littoral.

History.—Specimens of this species were first mentioned by Prof. F. Jeffrey Bell who in 1902 recorded some that had been collected by Prof. J. Stanley Gardiner at Fadiffolu in the Maldive Islands under the name of *Antedon laevissima.*

In a paper on the crinoids of the coasts of Africa published in 1911 I described *Decametra möbiusi* from a single specimen from Mauritius, and on the following page described *D. modica* from three specimens from Bagamoyo. In a paper on a small collection of crinoids from the Indian Ocean published in July 1912, I recorded *Decametra moebiusi* from ?India without comment. In a paper on the crinoids of the Berlin Museum published on November 20, 1912, I listed the specimens of *Decametra* *modica* and *D. möbiusi* and gave their catalog numbers. In my memoir on the crinoids of the Indian Ocean published on November 22, 1912, I listed *Decametra modica*, giving the synonymy and habitat. I also listed *D. möbiusi*, giving the specimen from Mauritius and also others from Muhlos, Maldives, and Fadiffolu, Maldives, that I had examined at the British Museum in 1910. These had been included under the name *Antedon laevissima* by Prof. F. Jeffrey Bell in 1902. In a paper on the crinoids of the British Museum published in 1913 I listed one specimen of *Decametra moebiusi* from Fadiffolu, Maldives, and three from Muhlos, Maldives, giving notes on them. These were the specimens just mentioned.

Dr. Robert Hartmeyer in 1916 corrected the catalog numbers on the specimens of *Decametra möbiusi* and *D. modica* in the Berlin Museum.

In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I included *modica* in the key to the species of the genus *Decametra*, and in a footnote gave *D. möbiusi* as a synonym of it.

DECAMETRA sp.

Cyllometra sp. A. H. Clark, Zool. Anz., vol. 34, No. 11/12. 1909, p. 368.
Decametra sp. A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 164.

Remarks.—The German steamer *Gazelle* dredged in the southern Indian Ocean (exact locality and depth not recorded) a small mutilated example of some species of *Decametra*.

Genus OLIGOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, Notes Leyden Mus., vol. 3, 1881, p. 182, and following authors.

Oligometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (diagnosis; genotype *Antedon serripinna* P. H. Carpenter, 1881), p. 135 (referred to the Himerometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Himerometridae), p. 212 (occurs in West Indies [*Analeidometra*] and Japan); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 7 (list of included species); Amer. Nat., vol. 43, 1909, p. 254 (represented in Red Sea [refers to *Decametra*]); Vid. Medd. Naturh. Foren. København, 1909, p. 174 (included in the Colobometridae); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (*Antedon serripinna* recorded by Chadwick from Red Sea not an *Oligometra*), p. 13 (common to southeast Africa and Ceylon, but not found in Arabian Sea); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (3 species peculiar to Australia [including *Oligometrides* and *Austrometra*]); Mem. Australian Mus., vol. 4, 1911, p. 725 (Australian species [including the species of *Oligometrides* and *Austrometra*]), pp. 730, 731 (in key), p. 734 (key to the Australian species), p. 775 (original reference; characters; range); Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 267 (really *Oligometrides*).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 371 (discussion).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 9 (in Australia distinctive local species [of *Oligometrides* and *Austrometra*, with 1 of *Oligometra*] replace the common East Indian forms), p. 11 (respresented in Ceylon region; western limit of the large species is at Ceylon), p. 12 (represented in Red Sea and southeast African regions), p. 22 (distribution in detail), p. 58 (in key), p. 168 (original reference; genotype), p. 323 (discussion); Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery of intermediates between this genus and *Decametra*), p. 111 (in key), p. 113 (in key), p. 128 (key to the included species).—Gislén, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, pp. 27, 29; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.—Ekman, Tiergeographie des Meeres, 1935, p. 283.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 48 (in key), p. 49 (key to Australian species).

Diagnosis.—A genus of Colobometridae including small species with 10 arms 30–83 (usually 40–60) mm. long in which the rather stout cirri are composed of 13–28 (usually 15–23) segments most of which are usually about as long as broad bearing dorsally a transverse ridge; and P_2 is enlarged, stiffened, and more or less strongly prismatic, with the distal portion of the prismatic ridges on each segment produced outward into a more or less broad finlike process or broad spine, a long spine with a broad base, or a tuft of spines; P_a is usually present, but may be absent.

Geographical range.—From Fuchow, Province of Fukien, China, and the Philippine Islands southward to the Tonga Islands, New Caledonia, Port Curtis, Queensland, and Baudin Island, Western Australia, and westward to the east coast of Africa from the Red Sea southward to Bagamoyo, Tanganyika Territory.

Bathymetrical range.—From the shore line down to 91 (?183) meters.

Remarks.—The genus *Oligometra* includes two species, one of which (*carpenteri*), confined to the north Australian region, is remarkably constant in its characters, while the other (*serripinna*), ranging from eastern Asia to east Africa, both individually and geographically is exceedingly variable—indeed one of the most perplexing of all comatulids.

The genus *Oligometra* is closely allied to *Decametra*, from which it differs in its characteristic P_2. But in *serripinna* P_2 is very variable, in some forms approaching the conditions found in some of the species of *Decametra*.

The species of *Oligometra* are found most abundantly in the littoral and sublittoral regions. They are rather local, but the individuals are usually common in the areas in which they occur.

History.—The genus *Oligometra* was proposed by me in 1908, with the genotype *Antedon serripinna* P. H. Carpenter, 1881. Included in this new genus were *adeonae*, *bidens*, *caribbea*, *japonica*, *pinniformis*, *serripinna*, and *carpenteri*. The genus was referred to the family Himerometridae. In 1909 another list of the species of *Oligometra* was published, including those given and in addition *gracilicirra*, *imbricata*, and *pulchella*, subsequently described. Later in 1909 *Oligometra*, *Cyllometra*, *Colobometra*, and *Cenometra* were associated in a new family, Colobometridae.

Since 1909 *Oligometra* has been progressively restricted in scope by the removal to other genera of most of the species originally included; *pinniformis* was removed to *Amphimetra* in 1911; *Analcidometra* was created for *caribbea* in 1911, *Oligometrides* for *adeonae* (of which *bidens* is a synonym) in 1913; and *Cotylometra* for *gracilicirra* in 1916; *japonica* is herein referred to *Iconometra* (see page 94).

This leaves in *Oligometra* only *carpenteri* and *serripinna*, *imbricata* and *pulchella* being forms of the latter.

KEY TO THE SPECIES IN THE GENUS OLIGOMETRA

a^1. Segments of P_2, except for one or two of the minute terminal ones, much broader than long with the edge toward the arm tip produced into a high uniform keel, and a high prominent tubercle or short blunt spine in the distal half on the edge toward the arm base (from the Aru Islands south to Port Curtis, Queensland, and Baudin Island, Western Australia; 15–57 meters) ---------- **carpenteri** (p. 210)

a^2. Segments of P_2 mostly, or largely, longer than, or at least as long as, broad, with the distal ends of the prismatic ridges more or less strongly produced, or with one or more spines (Province of Fukien, China, the Macclesfield Bank, and the Philippine Islands, southward to the Tonga Islands, New Caledonia, and New Guinea, and westward to the east coast of Africa from the Red Sea southward to Bagamoyo, Tanganyika Territory; 0–91 [?183] meters) --- **serripinna** (p. 216)

OLIGOMETRA CARPENTERI (Bell)

PLATE 29, FIGURES 157–160

Antedon carpenteri BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula), p. 157 (description; Port Curtis), pl. 10, figs. A, *a-c*.—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 54, 193, 366, 377.—A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 353 (listed).—HAMANN, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).—A. H. CLARK, Mem. Australian Mus., vol. 4, 1911, p. 714 (identity), p. 716 (credited to Australia by Carpenter); Crinoids of the Indian Ocean, 1912, pp. 31, 33 (identity).

Antedon milberti (part) BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 156 (Prince of Wales Channel); Proc. Zool. Soc. London, 1894, p. 394 (northwestern Australia, 8–15 fms.).

Antedon serripinna BELL, Proc. Zool. Soc. London, 1894, p. 394 (Holothuria Bank, 24 and 39 fms.).—A. H. CLARK, Mem. Australian Mus., vol. 4, 1911, p. 719 (correction of Bell); Crinoids of the Indian Ocean, 1912, p. 38 (same).

Oligometra carpenteri A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (listed); vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*); Amer. Journ. Sci., ser. 4, vol. 32 (old ser. vol. 182), No. 188, 1911, p. 130 (significance of distinctive characters); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (northwest Australia, 8–15 and 24–39 fms.), p. 441 (Australian tropical species occurring south to Baudin Island and Port Curtis), p. 443 (range on east coast), p. 444 (range on west coast), p. 446 (summary of west Australian records); Mem. Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia), p. 722 (occurs south to Port Curtis), p. 723 (northwest Australia; Baudin Island), p. 725 (distinct from *serripinna* but derived from same stock), p. 734 (in key), p. 775 (annotated synonymy; characters; Port Curtis; other records); Crinoids of the Indian Ocean, 1912, p. 31 (=*Antedon milberti*, part, and *A. carpenteri* Bell, 1884), p. 33 (=*Antedon carpenteri* P. H. Carpenter, 1888), p. 38 (=*Antedon milberti*, part, and *A. serripinna* Bell, 1894), p. 174 (synonymy; summary of previous records); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 37 (published references to specimens in the B. M.; localities); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of the distribution in Australia); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (in key; range), p. 130 (references; stations 273, 274), p. 275 (listed), pl. 28, fig. 105.—H. L. CLARK, The echinoderm fauna of Torres Strait, 1921, p. 24 (range), p. 192 and following (range in Australia).—MCNEILL and LIVINGSTON, Rec. Australian Mus., vol. 15, No. 2, 1926, pp. 193, 195 (Sir Edward Pellew Islands; occurrence).—H. L. CLARK, Rec. South Australian Mus., vol. 3, No. 4, 1928, p. 368 (Northern Territory, South Australia).—A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, May, 1929, p. 646 (Baudin Island; 8–15 fathoms).—H. L. CLARK, Great Barrier Reef Expedition, 1928–29, Scientific Reports, vol. 4, No. 7, 1932, p. 202 (station XIV); Echinoderm fauna of Australia, 1946, p. 49 (Australian localities).

Diagnostic features.—P_2 is exceedingly stout, usually curved strongly inward over the disk, composed of segments which, except for one or two of the minute terminal ones, are much broader than long with the edge toward the arm tip produced into a high uniform keel, and a high prominent tubercle or short blunt spine on the distal half on the edge toward the arm base.

Description.—The centrodorsal is thin discoidal with a broad flat or slightly concave dorsal pole 2 mm. in diameter, with slight rounded elevations at the base of each of the cirri. The cirrus sockets are arranged in a single regular and very closely crowded marginal row; they are higher than broad with straight lateral edges, a strongly arched proximal, and a slightly arched distal border.

The cirri are XV, 15–18, between 5 and 6 mm. long, and are strongly curved. The first segment is very short, the second is between three and four times as broad as long, and those following slowly increase in length so that those in the middle of the cirri are about twice as broad as long and the two or three outermost are about one-third again as broad as long. The segments in the proximal half of the cirri have strongly sinuous distal ends, but the distal ends of those in the distal half are straight, making a considerable angle with the straight proximal ends, so that the distal segments are wedge-shaped in lateral view. The bases of the cirri are much crowded and compressed laterally so that the first segment is very narrow, the second is half again as broad as the first, and the third is slightly broader than the second. From the third segment onward the cirri, as viewed dorsally, taper rather rapidly to the tip. In lateral view the width is uniform throughout. The third-fifth segments bear dorsally a long narrow straight and low transverse ridge just within the distal edge. On the segments immediately following the ends of this ridge curve upward and outward to the distal angles of the segments. These lateral extensions are soon lost, and the ridge gradually again becomes straight and moves to a position near the proximal end of the segments. In lateral view the ridge appears as a small triangular point. The opposing spine is triangular, sharp, and erect, arising from the whole dorsal surface of the penultimate segment; its height is equal to about half the width of that segment. The terminal claw is as long as, or longer than, the penultimate segment, and is rather strongly curved basally, becoming almost straight distally.

The radials are wholly concealed. The IBr_1 are very short, between 5 and 6 times as broad as long, with straight and parallel proximal and distal borders and slightly diverging lateral edges, which have a slightly produced border. The IBr_2 (axillaries) are triangular with the lateral angles truncated. They are very short, about three times as broad as long, with the distal angle obtuse, the distal sides very slightly concave, and the lateral edges, which are slightly shorter than the lateral edges of the IBr_1, straight and slightly produced into a narrow thin flange like border. There is a small though well-marked synarthrial tubercle on the articulation between the elements of the IBr series. The IBr series as a whole are short and broad, moderately convex dorsally, and in lateral apposition with their neighbors through the slight lateral extension of their margins.

The 10 arms are 60 mm. long. The first brachials are slightly wedge-shaped, about four times as broad as the median length, with the outer edge from one-third to one-half again as long as the inner. The inner edges are in close contact for their entire length. The second brachials are more pronouncedly wedge-shaped, with the outer edge about as long as that of the first brachials, but the inner edge only about half as long as that of the first brachials. The first syzygial pair (composed of brachials 3+4) is about three times as broad as the median length, slightly longer interiorly than exteriorly. The next four or five brachials are very short, about five times as broad as the median length, with the proximal and distal sides approximately parallel. The brachials succeeding are sharply triangular, somewhat over twice as broad as the greatest length, in the outer half of the arm becoming very obliquely wedge-shaped with the distal border more or less prominent, later elongating so that the terminal brachials are bluntly wedge-shaped, nearly as long as broad, with very oblique distal ends. The brachials are evenly rounded dorsally, and the first two have slightly produced outer borders by which they are in contact with their neighbors.

Syzygies occur between brachials 3+4, 9+10, and 14+15 or 15+16, and distally at intervals of from 6 to 11 muscular articulations. The usual second syzygy may be omitted, in which case the second syzygy is between brachials 13+14.

P_1 is 3.5 mm. long with 16 segments, very strongly prismatic, very stout basally but tapering rather rapidly in the proximal half, less rapidly in the distal. The first segment is much broader than long with the adoral end slightly produced and swollen into a broad rounded tubercle. The second segment is longer, and also broader, than the first, about three times as broad as long. The segments following slowly increase in length so that the last three or four, disregarding the strong lateral processes, are somewhat longer than broad. From the third segment onward the middle of the outer side is conspicuously carinate; on the fifth and following this carination projects as a thin keel of progressively increasing height, on the subterminal segments reaching a height equal to more than half the width of the segment. The keel at first is of uniform height, with the proximal end rounded and the distal truncated, but it soon becomes highest at the distal end of the segments, its edge running in a broad curve to near the base. This makes the profile of the outer portion of the pinnule very deeply serrate, the proximally convex and distally straight teeth being separated by intervals somewhat less than their own area. The edges of the segments toward the arm tip are similarly, though not so extravagantly, modified. P_2 is nearly or quite 5 mm. in length, very stout, tapering rather slowly with the distal third flexible though not particularly slender, composed of 13 or 14 segments of which the first is trapezoidal with the distal side the longest, about three times as broad as long, the distal side twice as long as the proximal. The second segment is wedge-shaped, broader than the first, twice as long on the side toward the arm tip as on the adoral side, more than twice as broad as the greatest length. The third segment is less strongly wedge-shaped, the side toward the arm tip being only slightly longer than the adoral side; it is somewhat more than twice as broad as long. The segments following have parallel proximal and distal ends and very slowly increase in length distally, the small terminal segments being, if the long lateral processes are disregarded, slightly longer than broad. On the edge toward the arm tip the segments are produced into high thin carinate processes, these processes on the second-fourth segments having the profile straight and parallel to the axis of the pinnule, those on the segments following having the profile convex, later becoming rounded angular, the process being very high at the distal end of the segment, turning a sharp angle and running in practically a straight line to the base. In the midline of the pinnule each segment bears in the outer half a large very high rounded or more or less flattened tubercle directed more or less toward the arm tip. On the segments in the outer half of the pinnule this becomes a long process directed outward nearly as long as the width of the distal end of the segment; its distal edge continues in a straight line the distal border of the segment, its proximal border running inward from a sharply rounded apex to the base. The distal half of the pinnule has on both sides a strongly serrate profile, the serrations being much higher on the outer than on the inner side. P_3 is 3 mm. long with 10–12 segments, very much more slender than P_2, more slender and more evenly tapering than P_1, the segments becoming about as long as broad on the seventh and twice as long as broad terminally. The pinnule is rather strongly prismatic. The adoral edge of the segments is produced into a moderate thin rounded carination which disappears on the small terminal segments, and the midline of all the segments beyond the basal is sharply gabled or more or less carinate. P_4 is 3 mm. long with 12 segments and resembles P_3; the terminal segment is a small conical point, and the three preceding this are somewhat over twice as long as broad. The pinnules following resemble P_4. The distal pinnules are 3.5 mm. in length with 12 segments of which the first is much broader than long, the second is about three times as long as broad, and the remainder are about twice as long as broad or slightly longer. They are roundedly prismatic with the adoral ventrolateral border of the segments slightly produced in the form of a thin rounded keel.

The color is purple with a conspicuous narrow median band on the division series and arms, gradually fading out after the proximal third, the lateral borders of the brachials, and the pinnules light yellow.

The preceding description is based on two specimens from the Aru Islands collected by the *Siboga*.

Notes.—Bell's original description of *Antedon carpenteri*, which was based upon a series of specimens from Port Curtis, is as follows:

> Centrodorsal a flattened disk; about 12 marginal cirri, of almost 20 short joints, of which the lowest are almost twice as broad as they are long; it is not till we reach the penultimate one that we see a distinct spine, though the dorsal surface of most of them is produced into a minute protuberance.
>
> First radials not visible; the second [IBr$_1$] do not or do only slightly touch, united to the third [IBr$_2$] by ligament. Ten arms. First brachials touch, they are nearly oblong and more than twice as wide as long; the second are a little wider on their outer than their inner side; the third with a syzygy; fourth to sixth oblong, seventh wider on inner than outer side, eighth wider on their outer than inner, and so on alternately; twelfth and thirteenth serrated at their distal edge; the fourteenth syzygial. Thence from four to seven joints between each syzygy. 130-180 joints in the arm.
>
> The second pinnules on the fourth brachial are very stout, with extraordinarily wide joints, which are armed on either side by spinous projections; the first pinnule is a little longer than the third.
>
> Colour white, with purple bands or patches, not always developed at the syzygies. The middle line of the arm often white.
>
> Arm about 40 millim. long, disk 6 millim. in diameter, cirri less than 9 millim. long..
>
> This species has some considerable resemblances to *A. serripinna*, from which, however, the pinnules alone would, as Mr Carpenter assures me, be sufficient to distinguish it.
>
> Port Curtis.

I have examined the four specimens collected by the *Alert* at Port Curtis in the British Museum, one of which has the arms 55 mm. long.

The single specimen dredged by the *Magneta* at station XIV is according to Dr. Hubert Lyman Clark, light brown, with the arms faintly banded (distally) or striped (proximally).

The specimens from *Siboga* stations 273 and 274 have the arms about 50 mm. long.

Messrs. McNeill and Livingstone recorded two alcoholic specimens brownish ochre in color from the Sir Edward Pellew Islands. One of these, now in the Australian Museum, has one oral arm 75 mm. in length.

Dr. H. L. Clark said that in the specimen from off the Northern Territory the calyx is about 4 mm. in diameter and the arms are between 30 and 40mm. long. The cirri are XV, 16–17. The dorsal side, including the pinnules and cirri, is very light fawn-color, and the oral surface, including the inner side of the pinnules, is dark brown.

The specimen from Holothuria Bank in 44 meters has the cirri XIV, 13–14.

The specimen from Holothuria Bank in 71 meters is exactly like the specimens from Queensland (that is, Port Curtis) in the Australian Museum. The cirri are XI 16–18.

Both of the specimens recorded from Baudin Island are small. There is a possibility that both records are based upon the same individual.

Localities.—Port Curtis, Queensland; 13 meters; H. M. S. *Alert* [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1907, 1908, 1911, 1912, 1913] (1, B.M.). Same; 20 meters; sand and shells [Bell, 1884; A. H. Clark, 1911, 1913] (3, B. M.).

Port Curtis, Queensland [A. H. Clark, 1911] (3, U. S. N. M., 35308; Austr. M.).

Magneta station XIV; 0.5 mile southeast of Lizard Island, off Cape Flattery (north of Cooktown), Queensland; 35 meters; shell gravel; rich *Halimeda*; March 7, 1929 [H. L. Clark, 1932].

Prince of Wales Channel, Torres Strait; 13–16 meters; sand; H.M.S. *Alert* [Bell, 1884; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Queensland (this refers to Port Curtis and the Prince of Wales Channel) [P. H. Carpenter, 1888; A. H. Clark, 1912].

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands (pearl banks); 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (4, U. S. N. M., E. 436: Amsterdam Mus.).

Siboga station 274; near the Jedan Islands, eastern coast of the Aru Islands (lat. 5° 28′ 12″ S., long. 134° 53′ 54″ E.); 57 meters; sand and shells; stones; December 26, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Sir Edward Pellew Islands, in the southwestern portion of the Gulf of Carpenteria; Surg. Lieut. Comdr. W. E. J. Paradice, R.A.N.; H.M.S. *Geranium* [McNeill and Livingstone, 1926].

From cable off Northern Territory, November 1890 [H. L. Clark, 1928].

Holothuria Bank, northwestern Australia; 44 meters [Bell, 1894; A. H. Clark, 1911, 1912, 1913]. (1, B. M.). Same; 71 meters [Bell, 1894; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Bassett-Smith Bank; 16 meters [A. H. Clark, 1911, 1912, 1913] (2, B. M.).

Baudin Island, northwestern Australia; 15–27 meters [A. H. Clark, 1911, 1912, 1913] (1, B. M.). Same locality and depth [A. H. Clark, 1929] (1, B. M.).

Northwestern Australia; 15–27 meters (this refers to the locality immediately preceding) [Bell, 1894; A. H. Clark, 1911, 1912, 1913] (2, B. M.).

Geographical range.—Aru Islands and northern Australia south to Port Curtis, Queensland, and Baudin Island, Western Australia.

Bathymetrical range.—From 13 to 57 meters.

Occurrence.—Frank A. McNeill and A. A. Livingston wrote that the two specimens they recorded from the Sir Edward Pellew Islands were found clinging to the stems of an alcyonarian, probably *Iciligorgia* sp., no doubt obtained in deep water. On the same stem of ?*Iciligorgia* were numerous juvenile *Ophiothela* sp.

History.—This species was first described and figured under the name *Antedon carpenteri* by Prof. F. Jeffrey Bell in his report on the echinoderms of the *Alert* collections published in 1884. At the same time he listed a specimen from the Prince of Wales Channel, Torres Strait, under the name of *Antedon milberti*.

In the *Challenger* report on the comatulids published in 1888 Dr. P. H. Carpenter placed *Antedon carpenteri* in the key to the species of the *Milberti* group, pairing it with *A. serripinna* from which it was distinguished by having large processes on the lower segments of P_2, this pinnule in *serripinna* being simply serrate. Carpenter gave as the locality for the species "Queensland."

In 1894 Professor Bell recorded specimens of this species under the name *Antedon milberti* from northwestern Australia in 8–15 fathoms, and under the name of *Antedon serripinna* from Holothuria Bank in 24 and 39 fathoms. The specimens from northwestern Australia were from Baudin Island although Bell did not indicate this.

In my first revision of the old genus *Antedon* published in 1907 I retained *carpenteri* in the genus *Antedon* as therein restricted. Upon the establishment of the new genus *Oligometra* by me in 1908, *carpenteri* was transferred to it, and it was listed as a member of this genus in my revision of the family Himerometridae published early in 1909. Later in 1909 I compared *Oliogometra carpenteri* with my new species *Oligometra* (*Decametra*) *studeri*. In my memoir on the recent crinoids of Australia published in 1911 I included in the synonymy the specimens listed by Bell in 1894 under *Antedon milberti* and *A. serripinna*, recorded three previously unknown specimens from Port Curtis, and gave all the localities from which the species was known, the data being taken from the labels of specimens in the British Museum. In my report on the crinoids collected by the Hamburg Southwest Australian expedition published in 1911, I discussed the range of this species in Australia, using the data given in the memoir preceding. In my memoir on the crinoids of the Indian Ocean published in 1912 I gave the synonymy of *Oligometra carpenteri* and its known habitat and bathymetrical range. I remarked that in London I had been able to examine the specimens upon which the record of *Oligometra serripinna* in northwestern Australia was based and found that they were in reality, as I had long suspected, examples of *O. carpenteri*. In a paper on the crinoids of the British Museum published in 1913 I recorded and gave notes on three lots of specimens collected by the *Alert* at Port Curtis and in the Prince of Wales Channel that I had found identified by Professor Bell as *Antedon carpenteri* and *A. milberti*, and five lots from northwestern Australia—Holothuria Bank, Bassett-Smith Bank, Baudin Island, and "Northwestern Australia"—that had been identified by Bell as *Antedon serripinna* and *A. milberti*. The depths, which had been omitted by Bell in his *Alert* report, were given with all the records. In 1915 I gave a detailed account of the distribution of this species on the coasts of Australia. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918, I recorded 4 specimens from station 273 and 2 from station 274.

In 1921 Dr. Hubert Lyman Clark discussed the distribution of this species on the Australian coasts. Dr. Clark wrote that Merton took five specimens in June 1908 on the northern coast of Little Kei Island. Merton's specimens were recorded and described by Dr. August Reichensperger in 1913 under the name *Oligometra serripinna* and belong to that species, not to *O. carpenteri*.

In 1926 Frank A. McNeill and A. A. Livingstone recorded two specimens from the Sir Edward Pellew group of islands in the southwestern part of the Gulf of Carpenteria, and gave notes on their occurrence.

In 1929 I recorded a small specimen from Baudin Island in 8–15 fathoms that had been sent me for identification by the British Museum. This is probably the same specimen that I examined in London in 1910 and recorded from that locality in 1913. At the time I studied the specimen at the British Museum I failed to label it.

In 1932 Dr. Hubert Lyman Clark recorded a single small specimen from *Magneta* station XIV, in 19 fathoms, that had been collected during the work of the Great Barrier Reef Expedition, 1928–1929.

OLIGOMETRA SERRIPINNA (P. H. Carpenter)

Diagnostic features.—Segments of P_2 mostly, or largely, longer than, or at least as long as, broad, with the distal ends of the prismatic ridges more or less strongly produced, or with one or more spines.

Remarks.—In addition to the typical form and the minor variations associated with it, *Oligometra serripinna* has seven strongly marked varieties each more or less definitely restricted to a limited region that deserve special notice.

In the same region, if not actually at the same station, *serripinna* is found with *erinacea, imbricata, macrobrachius,* and *occidentalis.* These forms may therefore be regarded as localized varieties. Typical *serripinna* has not been found in the areas inhabited by *electrae, chinensis,* or *caledoniae.* These forms may therefore be regarded as true geographical races or subspecies.

It has seemed most practicable to treat each of these forms separately.

KEY TO THE VARIETIES AND SUBSPECIES OF OLIGOMETRA SERRIPINNA

- a^1. Distal edges of the brachials in the proxmial third of the arm turned abruptly outward and much produced.
  - b^1. Distal edges of the brachials in the proximal third of the arm turned abruptly outward and greatly produced, with a scalloped and irregular crest; proximal to the second syzygy this eversion becomes restricted to the central portion of the distal edge and may be more or less resolved into high tubercles or blunt spines; anterior angle or axillary usually produced dorsalward, or bearing three prominent tubercles; lateral processes of the segments of P_2 high and broad, usually with a truncated distal angle (northeastern Ceylon; 9–13 [or 11–15] meters)-- **var. erinacea** (p. 237)
  - b^2. No modification of the produced distal edges of the lower brachials, or of the edges of the elements of the IBr series; segments of P_2 usually with very slight lateral processes (Ganjam coast, Madras Presidency, India; ?Tranquebar; 44–55 meters)----**var. imbricata** (p. 236)
- a^2. Production of the distal edges of the earlier brachials moderate or lacking.
  - b^1. Very ornate, with extravagantly developed processes on the proximal pinnules (Red Sea, off Eritrea; 36 meters)-- **var. electrae** (p. 241)
  - b^2. Not ornate; processes on the proximal pinnules not extravagantly developed.
    - c^1. Outer cirrus segments all with a transverse ridge, sometimes narrowed terminally into a median tubercle; P_a present; arms not more than 83 mm. long, and seldom over 60 mm.
      - d^1. P_2 not greatly enlarged, becoming delicate distally, with the distal segments twice as long as broad or even longer, the profile serrate in the distal half; cirri relatively long and slender, with up to 24 segments; second-fourth segments of lower pinnules narrowly carinate (Province of Fukien, China; littoral)----------- **subsp. chinensis** (p. 244)
      - d^2. P_2 stouter, markedly enlarged; cirri shorter and stouter with usually 18–20 segments; earlier segments of proximal pinnules not carinate.
        - e^1. Profile of P_2 strongly serrate (from Hong Kong, the Macclesfield Bank, and the Philippine Islands southward to New Guinea and westward to the Pedro Shoal, the Maldive Islands, and Bagamoyo, Tanganyika Territory; 0–91 [?183] meters). **serripinna** (p. 217)
        - e^2. Profile of P_2 scarcely serrate.
          - f^1. Segments of the pinnules following P_2 with strongly projecting distal edges and angles; P_2 with up to 19 segments (from Mauritius and Cargados Carajos to the Red Sea; 0–55 meters)--------------------------- **var. occidentalis** (p. 239)

f^2. Distal ends of the segments of the pinnules following P_2 not produced; P_2 with up to 23 segments (New Caledonia to the Tonga Islands; littoral).
subsp. **caledoniae** (p. 241)

c^2. Outer cirrus segments dorsally usually with paired tubercles; P_a usually absent; arms up to 110 mm. long (from the Philippines to the Kei Islands and Amboina; 0–50 meters) .... var. **macrobrachius** (p. 232)

OLIGOMETRA SERRIPINNA SERRIPINNA (P. H. Carpenter)

Plate 27, Figure 143; Plate 28, Figures 153–155; Plate 29, Figure 156

[See also vol. 1, pt. 1, fig. 352 (cirrus), p. 291; pt. 2, figs. 58, 59 (radial pentagon), p. 33; fig. 315 (proximal pinnules), p. 227; figs. 494–497 (pinnule tips), p. 273; fig. 780 (ambulacral deposits), p. 366.]

Antedon serripinna P. H. Carpenter, Notes Leyden Mus., vol. 3, 1881, pp. 175, 182 (description; Andai, New Guinea).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed), p. 534 (specific formula). P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 746 (specific formula).—Bell, Rep. Zool. Coll. H. M. S. *Alert*, 1884, p. 157 (comparison with *carpenteri*).—P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, pp. 54, 192, 198, 366, 378.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 82 (in part; specimen from Andai, New Guinea; the specimens from Tonga described are *O. caledoniae*).—Chadwick, *in* Herdman, Report Ceylon Pearl Oyster Fisheries, pt. 2, Suppl. Rep. 11, 1904, p. 153 (stations XXIII, XXIV, XXV, off Trincomalee; notes), pl., figs. 1, 2, 2A.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).—A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 353 (listed); Notes Leyden Mus., vol. 33, 1911, p. 176 (identity); Crinoids of the Indian Ocean, 1912, pp. 34, 37, 38, 40, 41 (identity of previous references).

Antedon carinata Bell, Proc. Zool. Soc. London, 1894, p. 396 (Macclesfield Bank, 29–32 fms.).—Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 4 (Macclesfield Bank).

Oligometra serripinna A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (listed); vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*); Vid. Medd. Naturh. Foren. København, 1909, p. 179 (synonymy; includes *cupulifera* and *pulchella*; Singapore; recorded from the Philippines, Ceylon, and the Red Sea [last is *Prometra chadwicki*], descriptions of specimens), p. 180 (compared with *O. imbricata*), p. 193 (collected at Singapore by Svend Gad); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast coast of Africa [*occidentalis*], p. 13 (common to southeast Africa and Ceylon, but not occurring in the Arabian Sea), pp. 33, 34 (compared with *O. s. occidentalis*); Notes Leyden Mus., vol. 33, 1911, p. 176 (identity), p. 189 (includes *pulchella*; redescription of the type); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 254 (compared with *O. caledoniae*); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (discussion of varieties of *serripinna*); Rec. Indian Mus., vol. 7, pt. 3, No. 26, 1912, p. 269 (arms compared with those of *O. intermedia*), p. 270 (*Investigator* Station 95; Arrakan coast); Crinoids of the Indian Ocean, 1912, p. 34 (=*Antedon serripinna* P. H. Carpenter, 1888), p. 37 (=*A. serripinna* Hartlaub, 1891), p. 38 (=*A. carinata* Bell, 1894), p. 40= (*A. serripinna* Chadwick, 1904), p. 169 (synonymy; localities; detailed descriptions and comparisons); p. 323 (off Gopalpore, 25–28 and 30–38 fms.; notes); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in east Asia), p. 182 (San Bernardino Strait); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 38 (published reference to the specimen in the B. M.; Macclesfield Bank, 29–32 fms.).—Reichensperger, Abh. Senck. naturf. Ges., vol. 35, No. 1, 1913, p. 83 (Kei Islands), p. 105 (details of the specimens; notes).—A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance).—H. L. Clark, Spolia Zeylania, vol. 10, pt. 37, 1915, p. 93 (occurs at Ceylon).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (in key; range), p. 130 (synonymy; notes; Stations 164, 258), pp. 273, 275 (listed).—Gislén, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 29 (comparison with *Prometra* [*Decametra*] *perplexa*).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 646 (Muhlos, Maldives; notes); Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 551 (listed), p. 560 (Madras; notes); Temminckia, vol. 1, 1936, p. 309 (Sipankot; Sibutu; notes).—Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 4 (Macclesfield Bank), p. 5 (range).—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 104.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 49 (Australian locality).

Oligometra pulchella A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 226 (description; Singapore); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 222 (*Albatross* station 5139); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 399 (*Albatross* station 5248); Vid. Medd. Naturh. Foren. København, 1909, p. 180 (synonym of *serripinna*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129, footnote (=*O. serripinna*).

Oligometra occidentalis (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 382 (Bagamoyo); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (southeastern Africa).

Oligometra serripinna occidentalis (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 401 (Bagamoyo).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (specimen from Bagamoyo in U. S. N. M.).

Oligometra concinna A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 172 (Puri; detailed description as a form of *serripinna*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129, footnote (=*O. serripinna*).

Oligometra carpenteri (part) H. L. Clark, The echinoderm fauna of Torres Strait, 1921, p. 24 (Merton's specimens from Little Kei I.).

Oligometra serripinna serripinna A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 101 (range).

Diagnostic features.—P_2 is stiffened and enlarged, though not exceptionally stout, straight or with the outer portion curved away from the disk, composed of segments which are mostly, or largely, longer than, or at least as long as, broad, with the distal ends of the prismatic ridges more or less strongly produced or bearing one or more spines, so that the profile of the pinnule as a whole is more or less strongly serrate.

Description.—The centrodorsal is thin discoidal with the broad circular dorsal pole, which is 2 mm. in diameter, flat, the border slightly raised at the base of each cirrus. The cirrus sockets are arranged in a single regular marginal row. They are much crowded so that they are about twice as high as broad with the lateral borders straight and the upper and lower borders strongly arched.

The cirri are XV, 20, 8–9 mm. long, short, rather stout, and strongly recurved. The first segment is very short, the second is about four times as broad as long, and those following gradually increase in length to the three or four terminal, which are about twice as broad as the median length or slightly longer. The second segment has the distal edge dorsally produced and serrate. On the segments following this becomes a prominent narrow transverse ridge with a straight crest situated near the distal edge. Distally the ridge gradually moves proximally so that on the segments in the outer third of the cirri it is in the middle of the dorsal surface of the segments. In the terminal fourth of the cirri it narrows so that on the antepenultimate segment it is usually scarcely more than a laterally broadened tubercle. The opposing spine is erect, conical, rather short, scarcely one-third the width of the penultimate segment in height, and arises from only a portion of the dorsal surface. It is sometimes more or less broadened laterally. Viewed dorsally the cirri are seen to be much compressed at the base, the first segment being only about two-thirds as broad as the second, which is usually slightly less broad than the third. From the third segment onward the cirri remain of about the same width to the middle, then gradually narrow to the tip.

The distal edges of the radials are even with the rim of the centrodorsal, or extend very slightly beyond it. They are produced upward, somewhat abruptly, in the interradial angles, where they are separated by narrow grooves. The IBr_1 are very short, from five to six times as broad as long, with the proximal and distal edges somewhat swollen. The IBr_2 (axillaries) are rhombic, twice as broad as long. There is a prominent high and narrow synarthrial tubercle on the articulation between the elements of the IBr series. The IBr series are broad and are almost or quite in lateral contact.

The 10 arms are 60 mm. long. The first brachials are wedge-shaped with the exterior length about twice as great as the interior, nearly three times as broad as the exterior length, interiorly united for almost their entire length. The second brachials are of about the same size, with the ends slightly more oblique. There is a prominent synarthrial tubercle on the articulation between the first two brachials, the lower element of which, on the first brachial, is very broad. The first syzygial pair (composed of brachials 3+4) is nearly twice as broad as the median length, and is slightly longer interiorly than exteriorly. The next five brachials are nearly oblong, between three and four times as broad as long, those following becoming sharply triangular, half again as broad as the greatest length, with the distal ends somewhat produced and finely spinous. In the outer half of the arm the brachials become wedge-shaped and very slowly elongate, so that those at the arm tip are as long as, or slightly longer than, broad.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 24+25 (most commonly between brachials 16+17), and distally at intervals of from 5 to 10 (most commonly 6 to 8) muscular articulations.

P_1 is 4.2 mm. long, tapering more rapidly in the proximal than in the distal half, rather strongly prismatic, with 16 segments. The first segment is short, about three times as broad as long in the median line, with the proximal border in the form of an obtuse angle, the distal border straight, and the short lateral borders convex. The second segment is about twice as broad as long, and is oblong. The segments following gradually increase in length so that the outermost are about twice as long as broad. The second segment has a broadly rounded prismatic ridge. On the segments following this rapidly becomes narrower and soon very narrow, the outer half of the pinnule being much flattened. In the outer half of the pinnule the side toward the arm tip is serrate, the ends of the segments along the prismatic ridge projecting beyond the bases of the segments succeeding. P_2 is 5.8 mm. long, much larger and stouter than P_1 and tapering more gradually, strongly prismatic, with 14 segments of which the first is about twice as broad as long with the proximal border forming an obtuse angle of about 120°, the distal border straight, and the short lateral borders somewhat convex. The second segment is oblong, about twice as broad as long. The segments following slowly increase in length so that the outermost are about twice as long as broad. The central portion of the outer side of the third segment is broadly raised. On the segments following this elevation of the central portion rapidly becomes sharp so that from the fifth onward the segments are strongly flattened with a sharp prismatic ridge. On the third and following segments the outer portion of the prismatic ridge is produced outward so that the distal ends of the segments at the prismatic ridges extend considerably beyond the bases of the segments following, giving the pinnule a serrate profile. These extensions of the prismatic ridge usually bear a few coarse teeth. P_3 is 3.9 mm. long with 14 segments, less stout basally than P_2 and becoming slender in the distal half. The first segment is between two and three times as broad as long, the second is about twice as broad as long, and those following increase in length so that the terminal are nearly or quite three times as long as broad. From the third onward the distal edges of the segments are slightly produced and finely spinous, especially at the prismatic angles. P_4 is 3 mm. long with 13 segments, slightly more slender than P_3 and less sharply prismatic. It resembles P_3, but the distal edges of the segments are more strongly produced and are coarsely dentate. The pinnules following resemble P_4 but are somewhat more slender with longer segments which have more strongly produced and more strongly dentate distal ends.

The distal pinnules are 5.3 mm. long, very slender, with 20 segments of which those beyond the fourth are about three times as long as broad and have somewhat expanded ends. The last segment bears three strong hooks, one terminal and two lateral.

The specimen described is from Singapore.

Notes.—In one of the specimens from Hong Kong the centrodorsal is discoidal with the broad dorsal pole slightly less in diameter than the base, circular, and flat with an abruptly raised narrow rim. The sides are slightly concave and are entirely occupied by a single perfectly regular row of 20 almost oblong cirrus sockets which are about three times as high as broad. The proximal edge of the centrodorsal is slightly produced so that each cirrus socket, on the end toward the radials, has an arched rim extending out over it. The cirri are XX, 21–23. The IBr_1 may be unmodified or may bear near the distal end a high abrupt tubercle with a rounded apex, or even more or less capitate. The IBr_2 (axillaries) may be plain, or may bear in the middle of the proximal edge a tubercle similar to that on the distal edge of the IBr_1, but smaller. The middle of the distal edges are abruptly raised into a more or less prominent tubercle, which may be lacking on one side. The central portion of the first 9 to 13 brachials is abruptly raised and everted so that the proximal portion of the arm is very strongly serrate in lateral view. The brachials succeeding have the entire distal edge strongly produced and finely spinous, this feature dying away and finally disappearing at about the middle of the arm. P_2 has 13–15 segments which have the prismatic angles on the distal ends produced and spinous. P_3 may resemble P_2, but is usually like P_4.

A similar specimen has arms about 65 mm. long.

Another specimen has the segments of P_2 furnished with unusually prominent, abruptly raised, high, and distally dentate processes.

The specimen from San Bernardino Strait is small with the arms 37 mm. long.

The specimen from *Albatross* station 5248 is small and mutilated.

One of the specimens from off Jolo in about 36–55 meters has the arms 60 mm. long. The cirri are XVI, 16–18, from 8 to 10 mm. long. The centrodorsal is discoidal with a circular outline and a flat dorsal pole 2 mm. in diameter. P_1 is 4.5–5 mm. long with 14 or 15 segments, somewhat stouter at the base than usual, with the segments from the third onward progressively more sharply carinate, and those in the distal half flattened. P_2 is 6 mm. long with 13 or 14 segments, stouter than usual, with the processes at the distal angles rather strongly developed. P_a resembles P_2, but is much smaller.

A similar specimen has the arms 45 mm. long.

A third specimen has the arms about 40 mm. long; P_2 is not quite so stout.

Another specimen has the arms 60 mm. long and the cirri XVI, 15–22. P_1 is 4.5 mm. long with 12 segments of which the last 4 or 5 have the distal angles produced slightly beyond the bases of those succeeding. P_2 is 6.5 mm. long with 14 or 15 segments which beyond the fourth have the distal border slightly prominent and very finely spinous, this feature being most prominent at the prismatic angles; the third segment is about as long as broad, and the outermost segments are not quite twice as long as broad. P_3 resembles P_2, and is of about the same size, or very slightly smaller; it is composed of 13 segments. P_4 is 5 mm. long with 12 segments and resembles P_3. P_5 is 3.5 mm. long with 12 segments, and is more slender and more flexible than P_4.

In one of the remaining specimens P_2 is very stout, while in two others it is slender with elongated segments. The arms of two of these are 45 and about 60 mm. long.

In one of the specimens from off Jolo in about 46 meters the arms are 40 mm. long. This is a very slender individual. P_2 is 5 mm. long with 11 segments of which the first is half again as broad as long, the second is as long as, or slightly longer than, broad, the third is three times as long as the median width, and the remainder are between three and four times as long as the median width. The third and following segments are slightly constricted centrally. The distal edges of the third and following segments are finely spinous. P_3 resembles P_2, but is much smaller.

Three other specimens from the same locality and depth have the arms 40, 45, and 50 mm. long.

The largest of the six specimens from Sibutu has the arms 55 mm. long. In these specimens P_a is usually absent, but in some it is present on some arms. P_2 is stout with strongly to very strongly developed processes on the segments. On one of the specimens P_3 resembles P_2 on one of the arms.

Carpenter described the type specimen of *Antedon serripinna* from Andai, New Guinea, as follows: The centrodorsal is discoidal, bearing marginal cirri. The cirri are about XII, 18. The segments are thick, and none of them are longer than broad. The penultimate bears a blunt spine. The radials are scarcely visible even at the angles of the calyx. The IBr_1 are nearly oblong and are not united laterally. The IBr_2 (axillaries) are less than twice as long as the IBr_1 and are almost triangular with wide distal angles and slight backward projections from the middle of their bases. The 10 arms are about 30 mm. long. The first brachials are almost rhomboidal and are closely united laterally. The second brachials are distinctly shorter and more wedge-shaped. The first syzygial pair (composed of brachials 3+4) is transversely oblong or nearly square. The next few brachials are short and oblong, and those following are longer and sharply wedge-shaped, gradually becoming blunter toward the arm ends. The first syzygy is between brachials 3+4 and the next is usually from between brachials 12+13 to between brachials 16+17, the distal intersyzygial interval is usually 4 or 5 muscular articulations. The stoutest pinnules are P_2 and P_b. These consist of about 15 segments all but the uppermost of which are short, broad, and thick with their distal edges projecting beyond the base of the next segment so as to give the pinnule a serrated outline. P_1 and P_2 are slightly longer than P_a and P_b. Those immediately following are shorter and are composed of a few elongated segments, after which the length of the pinnules gradually increases, though it never much exceeds that of the large lower pinnules. The disk is barely 5 mm. in diameter and is naked and somewhat incised. Sacculi are closely set along the pinnule ambulacra but are rather farther apart on the arms. The color in alcohol is white with deep purple bands on the arms, especially at the syzygies.

I examined this specimen at the Leyden Museum in 1910. It fits closely the description of the form I called *pulchella*. The projection of the distal ends of the lower pinnule segments is not greatly accentuated. The purple bands on the arms are very narrow.

The specimen from *Siboga* station 164 has the arms 50 mm. long. P_2 is greatly enlarged with strongly marked processes. P_3 is small, like P_4.

All five of the specimens recorded by Reichensperger from Nuhu Tawun, Little Kei, agree almost completely with Carpenter's description of the type specimen from Andai, New Guinea. The smallest has an arm length of only about 43 mm. The cirri are XI, 15; the middle segments appear somewhat longer in relation to the width than in the larger specimens. The longest cirrus is 6 mm. long. P_2 is composed of 12 or 13 segments and shows prominently the distal serrate produced ends. The arm length of the largest specimens reaches 105 mm. (see page 234). These have the cirri XII–XIV, 18–20, from 8 to 9 mm. long. The cirri are stout with broad segments which on the dorsal side bear a prominent keel with evident small teeth. The serration of the proximal pinnules is sometimes very strongly developed and sometimes only feebly developed (*pulchella*). In the middle arm region the syzygies are fairly regularly spaced, mostly with an intersyzygial interval of 6–8 muscular articulations. A large individual is wholly dark brown-violet. The others have more or less broad light violet bands and spots. The smallest is dorsally light reddish.

The specimen from *Siboga* station 258 has rather slender cirri with 16–17 segments which beyond the eighth are about as long as broad. P_2 is much enlarged, much larger than the other pinnules, 7 mm. long, with 17 segments most of which are about as long as broad; the lateral processes are small and narrow (anterodistally) and are armed with fine spines. P_a is absent on all the arms of three postradial series, six arms in all. This individual approaches the African *occidentalis*.

The specimen from the Danish Expedition to the Kei Islands station 54 has the arms 40 mm. long. P_2 is slender with the processes on the distal angles of the segments unusually long.

The specimen from the Danish Expedition to the Kei Islands station 43 is small and slender.

The specimen from Banda has the arms 70 mm. long. P_2 is very stout, sharply prismatic, with the distal angles of the segments prominently spinous. The color is deep purple, the cirri flesh color.

The 10 specimens from the Danish Expedition to the Kei Islands station 75 are all small, as is that from station 74.

The specimen from the Danish Expedition to the Kei Islands station 104 is very small.

One of the specimens from Singapore was described as a new species under the name of *Oligometra pulchella* in the following terms:

The centrodorsal is discoidal with the large polar area circular, flat, and unmarked. The cirrus sockets are arranged in a single marginal row. The cirri are XIV, 16–23 (usually about 18), 7 mm. long, and comparatively slender. The first segment is short and those following gradually increase in length to the sixth which, with those succeeding, is about as long as broad. The fourth and following segments have a low transverse ridge extending entirely across their flattened dorsal surface which in the earlier is subterminal in position, at about the eighth becoming median. This ridge is finely spinous and appears as a very small dorsal spine in lateral view. The opposing spine is delicate, median in position, standing out at right angles to the dorsal surface of the penultimate segment, and not reaching quite half the width of that segment in height. The terminal claw is rather longer than the penultimate segment and is stout and strongly curved. The distal ends of the radials are even with the rim of the centrodorsal. The IBr_1 are short, four or five times as broad as their median length, with straight and free lateral edges. The IBr_2 (axillaries) are triangular, about twice as broad as long, and rise to a rather prominent synarthrial tubercle with the IBr_1. The 10 slender arms are about 60 mm. long. The first brachials are short, wedge-shaped, about twice as long exteriorly as interiorly, inwardly united for about the proximal half, the distal free edges diverging at rather more than a right angle. The second brachials are similar in shape to the first but slightly larger, rising in the proximal portion of the median line to a moderate synarthrial tubercle with the first. The first syzygial pair (composed of brachials 3+4) is slightly longer inwardly than outwardly, and is about twice as broad as the longer lateral length. The four following brachials are oblong, rather more than three times as broad as long. The second syzygial pair is wedge-shaped. The brachials following are triangular, not so long as broad, later becoming wedge-shaped, broader than long, and in the terminal portion of the arm as long as, or even longer than, broad. After about the tenth the brachials have rather strongly produced and overlapping finely serrate distal edges that give the dorsal surface of the arm a characteristically rough appearance. This feature begins to die away in the outer half of the arm, disappearing in the distal third. Syzygies occur between brachials 3+4 and 9+10 (rarely 10+11), from between brachials 14+15 to between brachials 17+18, and distally at intervals of 5–8 (usually 5) muscular articulations.

P_1 is about 4 mm. long, moderately slender, tapering evenly from the base to the tip. It is composed of 16 segments of which the first 2 or 3 are not quite so long as broad and the remainder are about as long as broad. In its outer half the pinnule becomes styliform and then flattened. The last 10 segments have their distal dorsal ends much produced so that the dorsal profile of the distal third, or rather more, of the pinnule is very strongly serrate. P_2 is about 6 mm. long, much stouter than P_1, much the largest pinnule on the arm. It is composed of about 19 segments of which the two first are not quite so long as broad and the remainder are approximately as long as broad. After the third segment the pinnule gradually becomes sharply styliform, the distal dorsal end of the segments projecting in a rounded laterally flattened tubercle which soon becomes very prominent. The base of this tubercle gradually involves more and more of the dorsal side of the segments, in the last 10 or 12 arising from the entire dorsal surface so that the terminal half of the pinnule, like the distal third of P_1, is deeply scalloped in profile. P_3 is about as large basally as P_1, but it is shorter, 3.5 mm. in length. It is composed of 12 segments of which the first three are not quite so long as broad, the fourth is about as long as broad, the remainder become gradually longer than broad, and in the terminal portion about twice as long as broad.

Beyond the third segment the pinnule becomes rounded triangular, and the distal dorsal edge of the segments is prominent, though not excessively produced. P_4 is slightly smaller and more delicate than P_3 with about the same number of segments which are proportionately longer distally. The pinnules following are similar, gradually becoming longer and more slender with longer segments. The rounded triangular condition of the distal portion of the pinnules is traceable to about the end of the proximal third of the arm. The distal pinnules are about 5.5 mm. long, exceedingly slender, with about 20 segments of which the first is trapezoidal, about twice as broad as long, the second is trapezoidal, about as long as the proximal width, the third is slightly longer than broad, and the remainder are elongated with swollen articulations, distally three times as long as broad or even somewhat longer.

The color in alcohol is white with small bands and patches of light brown on the arms, the distal half of the cirri becoming brownish. Other specimens are white similarly marked with deep violet, or entirely deep purple, sometimes with the two proximal pinnule pairs white, or occasionally brown; small specimens are yellow.

In the lot of eight specimens from Singapore six resemble the type specimen of *pulchella*. One is small with arms 40 mm. long, but otherwise similar to the type, and one is young with arms 13 mm. long and the cirri LX, 8–10, 3 mm. long. In the last the segments of the lower pinnules are elongate and do not exhibit the distally serrate condition so characteristic of the adults.

In another lot of 20 specimens from Singapore 12 are large, resembling the type specimen of *pulchella*, and 8 are small. Eight of the individuals, seven large and one small, were attached to a small sprig of a gorgonian.

Of the remaining specimens from Singapore three have the arms 65 mm. long. In some the lateral processes on the segments of P_2 are very slightly developed, and they may be reduced to a scarcely perceptible production of the distal ends of the segments at the prismatic angles.

The specimen from the Arrakan coast of Burma is small and immature.

The specimens from *Investigator* station 19, off Puri, were originally considered as representing a new species, *Oligometra concinna*, which was thus described:

The centrodorsal is thin discoidal with the bare polar area flat, 2 mm. in diameter. The cirrus sockets are arranged in a single closely crowded, though fairly regular, marginal row. The cirri are rather slender, relatively short, XIII–XVII, 19–21, 8 mm. long. The first segment is very short and those following slowly increase in length to the seventh or eighth which, with the remainder, is from as long as, to half again as long as, broad. The proximal segments are abruptly flattened ventrally; on the fourth or fifth the distal dorsal edge is slightly prominent, forming a low finely serrate transverse ridge across the end of the segment; on the succeeding segments this ridge increases in height and moves anteriorly, on the twelfth and following being median in position; distally the ridge very gradually narrows, becoming finally, on the antepenultimate, reduced to a sharp median tubercle. The opposing spine is much larger than the spine on the preceding segment, sharp, arising from the entire dorsal surface of the penultimate segment, the apex median in position, equal to about the distal width of the penultimate segment in height. The terminal claw is longer than the penultimate segment, stout, more strongly curved proximally than distally. The distal border of the radials is even with the rim of the centrodorsal; the distal angles of the radials are slightly separated. The IBr_1 are short, oblong, about four times as broad as long, not united basally. The IBr_2 (axillaries) are almost triangular, twice as broad as long, with the lateral edges only half as long as those of the IBr_1. The synarthrial tubercles are small but prominent.

The 10 arms are about 80 mm. long and are moderately slender. The first brachials are wedge-shaped, about twice as broad distally as the exterior length, interiorly united for the proximal two-thirds, the interior edges diverging widely in the distal third. The second brachials are of about the same size, irregularly quadrate. The first syzygial pair (composed of brachials 3+4) is slightly longer interiorly than exteriorly, twice as broad as the interior length. The next four brachials are oblong or slightly wedge-shaped, about three and one-half times as broad as long, those following becoming triangular, about twice as broad as long, and after the middle of the arm wedge-shaped, twice as broad as long, and in the terminal portion wedge-shaped and about as long as broad. From the ninth or tenth onward the brachials have rather prominently overlapping finely spinous distal ends which very gradually die away in the distal third of the arm. Syzygies occur between brachials 3+4, again from between brachials 13+14 to between brachials 15+16 (with sometimes an extra one between brachials 5+6 to 9+10), and distally at intervals of 4–6 (usually 5) muscular articulations.

P_1 is small and weak, from 4.5 to 5 mm. long, composed of 17 segments of which the first is small, irregularly quadrate, the second is wedge-shaped, twice as broad as the proximal (greater) length, the third is half again as broad as long, and those following gradually increase in length to the sixth which, with the remainder, is about as long as broad. From the third segment onward a dorsal ridge begins to develop along the median external line of the pinnule, after the seventh becoming a high carination. The eighth and following segments bear prominent processes on the distal border on the line of this carination which are triangular in shape, the apex terminal, arising from the whole exterior line of carination, the distal height being equal to about half the width of the segments. P_2 is 10–12 mm. long, much stouter than P_1 and by far the stoutest pinnule on the arm, and very stiff, tapering gradually from the base to a delicate tip; it is composed of 25 segments of which the first two are short and those following gradually increase in length to the fifth which, with the following, is about as long as broad, at the extreme tip becoming somewhat longer. The third and following segments are strongly carinate, the fourth and following bearing on their distal edges along this line of carination sharp and prominent anteriorly directed spines the bases of which do not involve more than the distal third, or at most the distal half, of the segments; similar, though smaller, spines occur along the inner distal edge of the pinnule. P_3 is most like P_1, 4 mm. long with 15 segments which become as long as broad on the fifth and from one-third to one-half again as long as broad distally. The second and third segments sometimes develop distal carinate processes, and the third and following are obscurely carinate dorsally with overlapping and finely spinous ends which are especially produced along the dorsal rounded-carinate ridge and along the ventral angles. The pinnules following are in general similar, the distal overlap of the segments gradually becoming more uniform in height, after P_7 becoming an even finely spinous projection which disappears altogether in the distal pinnules. The distal pinnules are slender and smooth, 9 mm. in length.

The color in alcohol is dull yellowish, the arms and pinnules thickly blotched with purple; or brownish yellow; or yellow with the division series and arm bases bordered with purple, and the pinnules, cirri, and occasional narrow bands on the arms purple; or violet, the cirri yellow.

One of the specimens from off the Ganjam coast in 27–46 meters is peculiar in having P_3 similar to, and nearly as large as, P_2, which is somewhat smaller than usual.

The two specimens from off Gopalpore in 46–51 meters have the lateral processes on the segments of the lower pinnules long, curved, and hooklike. The segments of the lower pinnules other than those that are enlarged are produced and spinous. One of the specimens has an arm length of 65 mm., and the other is slightly smaller.

Both of the specimens from off Gopalpore in 55–69 meters have an arm length of 60 mm. In one of them the distal ends of the segments of the lower pinnules are all produced and finely spinous, in addition to the production of the distal corners.

In one of the specimens from *Investigator* station 95 the synarthrial tubercles and the processes on the proximal pinnules are strongly marked.

One of the three specimens from *Investigator* station 92 has the processes on the proximal pinnules more pronounced than usual and the synarthrial tubercles prominent.

In the specimen from Madras the arms are 80 mm. long. The cirri are XV, 22–24, 10 mm. long. P_2 is 7 mm. long with 15 segments, very stout, with prominent processes at the prismatic angles of the segments.

The specimens from the Ceylon Pearl Oyster Fisheries investigations, as described by Chadwick, have the cirri XV, 17. The segments from the second to the antepenultimate have a strong dorsal transverse ridge which is near the distal end in the first few but becomes median and, viewed in profile, spine-like on the later ones. The opposing spine is strong. The arms are slender and serrate, and are composed of about 150 brachials. Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of 6–8 muscular articulations. P_1 is composed of 11 segments of which the first three are broad and the remainder are cylindrical, twice as long as broad, with two very minute spines projecting from their distal ends. P_2 is stouter than P_1 and nearly twice as long and is composed of 13 segments of very similar character. P_3 is composed of 9 or 10 segments and is smaller than P_1. P_a, P_b, and P_c are smaller than P_1, P_2, and P_3, but their component segments are similar, as are those of the next ten or twelve pairs, though in the latter the basal segments differ in diameter less markedly from their successors.

The seven specimens collected by the *Investigator* off the southern coast of Ceylon are all medium sized or small.

Of the two specimens from Muhlos, Maldive Islands, one has the arms about 50 mm. long. The cirri are XVI, 15–16, 7 mm. long. P_2 has 12 or 13 segments, the processes on the distal ends of the segments being of average development. The other specimen is similar but smaller, with the arms 40 mm. long.

The specimen from the Pedro shoal is large, with the cirri XVI, 21–23.

A small specimen from Bagamoyo appears to be referable to the typical form. The segments of P_2 bear prominent stout high tubercles or short, very stout, blunt spines on the distal ends at the prismatic ridges. The arms are about 25 mm. long. The cirri are about 6 mm. long with 14 segments of which the last four are about as long as broad. A few cirri, shorter, with 10–12 somewhat longer segments, occur between and below the regular peripheral cirri. These are juvenile cirri that later will be lost.

Localities.—Hong Kong (10, C. M.).

Macclesfield Bank; 53–58 meters [Bell, 1894; A. H. Clark, 1912, 1913] (1, B. M.).

San Bernadino Strait, between Luzon and Samar, Philippines (lat. 12°27′ N., long. 124°03′ E.); 91–183 meters; bottom temperature 16.11° C.; Captain Suensson [A. H. Clark, 1913] (1, C. M.).

Albatross station 5248; Gulf of Davao, Philippines; Lanang Point bearing S. 33° W., 0.4 mile distant (lat. 7°07′25″ N., long. 125°40′24″ E.); 33 meters; coral; May 18, 1908 [A. H. Clark, 1909, 1912] (1, U. S. N. M., 35309).

Albatross station 5139; in the vicinity of Jolo (Sulu), Philippines; Jolo light bearing S. 51° W., 3.6 miles distant (lat. 6°06′00″ N., long. 121°02′30″ E.); 36 meters; coral sand; February 14, 1908 [A. H. Clark, 1908, 1912].

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; about 36 meters; lithothamnion; March 17, 1914 (4).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; about 36–55 meters; sand and coral; March 19, 1914 (16).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; about 46 meters; sand; March 17, 1914 (2).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; about 46 meters; sand and coral; March 18, 1914 (7).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; about 36–55 meters; sand and coral; March 20, 1914 (5).

Sipankot, near Sibutu, Sulu (Jolo); 3–6 meters; *Willebrord Snellius*, September 10–14, 1929 [A. H. Clark, 1936] (1, L. M.).

Sibutu; 3–7 meters; *Willebrord Snellius*, September 15, 1929 [A. H. Clark 1936] (6, L. M.).

Andai, New Guinea [P. H. Carpenter, 1881, 1883, 1888; Bell, 1882, 1884; A. H. Clark, 1907, 1908, 1909, 1911, 1912] (1, L. M.).

Siboga station 164; between New Guinea and Misool (lat. 1°42′30″ S., long. 130° 47′30″ E.); 32 meters; sand, small stones, and shells; August 20, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Nuhu Tawun, northern coast of Little Kei, Kei Islands; Dr. H. Merton, June 16, 1908 [Reichensperger, 1913].

Siboga station 258; Tual anchorage, Kei Islands; 22 meters; lithothamnion, sand, and coral; December 12–16, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 43; about 35 meters; sand and coral; April 27, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; off Goenoeng, Banda; about 10 meters; sand; June 2, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 54 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; about 1 meter; February 28, 1922 (8).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 67; Java Sea (lat. 5°48′ S., long. 106°12′ E.); 38 meters; sand and shells; January 27, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 75; Sunda Straits (lat. 6°10′ S., long. 105°44′ E.); 40 meters; sand and shells; July 29, 1922 (10).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 74; Sunda Straits; 30 meters; stones and shells; July 29, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 104; Java Sea (lat. 5°52′ S., long. 106°04′05″ E.); 38 meters; stones and sponges; August 4, 1922 (1).

Singapore; shallow water; Svend Gad [A. H. Clark, 1908, 1909, 1912, 1918] (1, C. M.).

Singapore; shallow water; Svend Gad [A. H. Clark, 1909, 1912, 1918] (76, U. S. N. M., 36265, E. 1072; C. M.).

Investigator; Snod Island, Mergui Archipelago (lat. 12° N., long. 98°30′ E.) [A. H. Clark, 1912] (3, U. S. N. M., 35362, 35371 [original No. 63B], 36258; I. M.).

Investigator; Arrakan coast, Burma [A. H. Clark, 1912] (1, U. S. N. M., 35395 [original No. 20H]).

Investigator; Arrakan coast, Burma [A. H. Clark, 1912] (2, I. M.).

Investigator; one mile east of the Terribles, a line of rocks from 10 to 12 miles west of the west point of Ramree Island, on the coast of Arrakan, Burma (lat. 19°27′ N., long. 93°18′ E.); 24 meters [A. H. Clark, 1912] (5, U. S. N. M., 35329 [original N. 51B], 35361 [original No. 50B]; I. M.).

Investigator station 19; rocky bank off Puri, Orissa coast of India; 18 meters; sand; December 18, 1888 [A. H. Clark, 1912] (3, U. S. N. M., 35328 [original No. 3E], 35332).

Bengal Fisheries steamer *Golden Crown;* off the Ganjam coast of India; 15–29 meters [A. H. Clark, 1912] (7, I. M.).

Bengal Fisheries steamer *Golden Crown;* off the Ganjam coast; 27–46 meters; [A. H. Clark, 1912] (8, I. M.).

Bengal Fisheries steamer *Golden Crown;* off the Ganjam coast; 44–45 meters (3, U. S. N. M., 35340).

Bengal Fisheries steamer *Golden Crown;* off Gopalpore; 46–51 meters; September 23–27, 1909 [A. H. Clark, 1912] (2, U. S. N. M., 35326, 35330).

Bengal Fisheries steamer *Golden Crown;* off Gopalpore; 55–69 meters [A. H. Clark, 1912] (2, I. M.).

Investigator station 95; 5 miles southeast of Pundi Beacon, Ganjam coast; 27–46 meters; sand, shells, and corallines; March 3, 1890 [A. H. Clark, 1912] (6, U.S.N.M., 35311, 35320 [original No. 12E], 35322 [original No. 8E], 35325, 35369, 35400).

Investigator station 92; 2½ miles southeast of Santapillay light house, Vizagapatam coast of India; 13–15 meters; sand; February 24, 1890 [A. H. Clark, 1912] (3, U.S.N.M., 35384 [original No. 16E]; I.M.).

Madras; station 11; entrance to the harbor; 7–9 meters; Dr. S. W. Kemp, May 8, 1918 [A. H. Clark, 1932] (1, I.M.).

Ceylon Pearl Oyster Fisheries station XXIII; off Trincomalee, northeastern Ceylon; close to Swami Rock, Back Bay; 8–15 meters; mostly between 9 and 11 meters; sand and shells, and in places stones and coral; 1902 [Chadwick, 1904; A. H. Clark, 1912, 1918; H. L. Clark, 1915].

Ceylon Pearl Oyster Fisheries station XXIV; off Trincomalee, Ceylon; 2½ to 3 miles north of Foul Point; 44–84 meters; bottom hard and rough, probably rock; 1902 [Chadwick, 1904; A. H. Clark, 1912, 1918; H. L. Clark, 1915].

Ceylon Pearl Oyster Fisheries station XXV; off Trincomalee, Ceylon; ¾ to 1 mile northwest of Foul Point; 15 meters; bottom firm, orbitolites sand and nullipores; 1902 [Chadwick, 1904; A. H. Clark, 1912, 1918; H. L. Clark, 1915].

Off Trincomalee, Ceylon [Chadwick, 1904; A. H. Clark, 1912, 1918; H. L. Clark, 1915] (1, U.S.N.M., 35310).

Investigator; off the southern coast of Ceylon (lat. 6°01′ N., long. 81°16′ E.); 62 meters [A. H. Clark, 1912; H. L. Clark, 1915] (7, U. S. N. M., 35327 [original No. 33D], 35341; I. M.).

Muhlos, Maldive Islands; Prof. J. Stanley Gardiner [A. H. Clark, 1929] (2, B. M.).

Investigator; Pedro shoal, north of the Laccadive Islands [A. H. Clark, 1912] (1, U. S. N. M., 35331).

Bagamoyo, north of Dar-es-Salaam, Tanganyika Territory (formerly German East Africa) [A. H. Clark, 1912, 1918; Hartmeyer, 1916] (1, U. S. N. M., 35365 [original No. 4616]).

Geographical range.—From Hong Kong, Macclesfield Bank, and the Philippine Islands southward to New Guinea and westward to the Pedro Shoal, the Maldive Islands, and Bagamoyo, Tanganyika Territory, east Africa.

Bathymetrical range.—From the shore line down to 91 (?183) meters. Nearly all the records are from water of less than 50 meters in depth.

Occurrence.—This species is very frequently found firmly attached by the cirri to gorgonians, and a large proportion of the specimens I have examined had to be cut from such supports.

Chadwick records that many grayish mottled individuals were found upon a large colony of *Gorgonia* (*Rhipidogorgia*) *flabellum* from Ceylon Pearl Oyster Fisheries station XXIII.

History.—This species was first described by Dr. P. H. Carpenter in 1881 under the name of *Antedon serripinna* from a specimen from Andai, New Guinea, in the Leyden Museum.

In October 1882 Prof. F. Jeffrey Bell proposed a specific formula for it which was emended by Carpenter in April of the year following. In the *Alert* report published in 1884 Professor Bell compared his new species *Antedon carpenteri* with *A. serripinna* (see page 213).

In the *Challenger* report on the comatulids published in 1888 Carpenter included *serripinna* in the key to the species in the *Milberti* group, in which it was paired with *carpenteri* (see page 214).

Dr. Clemens Hartlaub in 1891 described in detail nine specimens from the Tonga Islands that he referred to *Antedon serripinna*, comparing them with the type specimen from Andai, New Guinea. The specimens from Tonga, however, are more properly referable to *O. caledoniae*.

In 1894 Professor Bell recorded some specimens from the Macclesfield Bank in 29–32 fathoms under the name of *Antedon carinata*.

Herbert Clifton Chadwick in 1904 recorded specimens of *Antedon serripinna* from stations XXIII, XXIV, and XXV of the Ceylon Pearl Oyster Fisheries investigations in the Gulf of Manaar under Prof. Sir William Herdman, and also from off Trincomalee. He gaves notes on these specimens, compared them with others, and figured the base of an arm with the first four pinnules and a cirrus.

In my first revision of the old genus *Antedon* published in 1907, I retained *serripinna* in *Antedon* as therein restricted. But in 1908 I made *serripinna* the type of my new genus *Oligometra*. Later in 1908 I described *Oligometra pulchella* from some specimens from Singapore collected by Svend Gad that had been sent to me for study by the Copenhagen Museum through the courtesy of Dr. Th. Mortensen. On December 23, 1908, in a paper on the first consignment of crinoids received from the United States Bureau of Fisheries steamer *Albatross*, at that time engaged in work among the Philippine Islands, I recorded *Oligometra pulchella* from station 5139, and noted that this species was previously known only from Singapore.

Both *pulchella* and *serripinna* were listed as species of *Oligometra* in my revision of the family Himerometridae published early in 1909. Later in 1909 in a paper on the crinoids of the Copenhagen Museum I recorded and gave notes on 60 specimens of *Oligometra serripinna* from Singapore that had been collected by Svend Gad. In the synonymy of this species I included *Antedon cupulifera* Lütken, MS. (in reality *O. caledoniae* from the Tonga Islands) and *Oligometra pulchella*. I said that *O. serripinna* was found in the Philippine Islands by the *Albatross* and occurs abundantly along the Indian coast to Ceylon, having been recorded also from the Red Sea. The Red Sea record is from Chadwick and was based upon specimens of *Decametra chadwicki* (see page 176). I remarked that I had at first thought that the specimens from Singapore represented a distinct species because of the rounded processes on the distal ends of the segments of the lower pinnules, these being large spines in *serripinna;* but the examination of a large amount of additional material showed that this is a character of great variability and that the form I had called *pulchella* is in reality nothing more than a strongly marked variety, imperceptibly grading into true *serripinna* and occurring with it throughout its range.

In a paper on a second consignment of crinoids received from the *Albatross* published in 1909 I recorded a small mutilated specimen of *Oligometra pulchella* from station 5248. In a paper on the recent crinoids of the coasts of Africa published in 1911 I included *Oligometra serripinna* in the list of species found on the southeastern coast from Mombasa to Cape Town, including all the outlying islands; but in the discussion of the species the form from Mauritius and Cargados Carajos was described as a new variety, *occidentalis*. In a paper on the crinoids of the Leyden Museum published in 1911 I gave notes on the type specimen of *Oligometra serripinna*, and in a paper on the crinoids of the Paris Museum published in the same year I compared it with my new *O. caledoniae*. In a paper on the crinoids of the Hamburg Museum published in 1912 I discussed the variations in *Oligometra serripinna*. The specimens described under that name from the Tonga Islands are in reality *O. caledoniae*, and that from Fuchow is *O. chinensis*. In 1912 I compared the arms of *O. serripinna* with those of my new species *O.* (*Prometra*) *intermedia*. I also recorded and gave notes on a specimen from *Investigator* station 95, and recorded a small and immature specimen from the Arrakan coast of Burma.

In my memoir on the crinoids of the Indian Ocean published in 1912 I recorded and gave notes on specimens of *Oligometra serripinna* from the Pedro shoal; from off northeastern Ceylon (in reality off the southern coast of Ceylon), in 34 fathoms; off Puri, in 10 fathoms; 1 mile east of the Terribles, in 13 fathoms; 2½ miles southeast of Santapillay lighthouse, in 7–8 fathoms; off the Ganjam coast, in 15–25 and also 8–16 fathoms; the Arrakan coast; and from Snod Island, Mergui Archipelago. I listed all the localities from which the species was previously known, including the Tonga Islands the specimens from which should have been referred to *O. caledoniae.* I wrote that when I was studying the crinoid collections belonging to the Zoological Museum at Copenhagen I had been unable to identify a pretty little species of *Oligometra* from Singapore which was abundantly represented therein with any species previously known, and I therefore described it as new under the name *Oligometra pulchella,* believing that the strongly rounded laterally flattened production of the distal dorsal ends of the segments of the more or less styliform lower pinnules amply served to distinguish it from *O. serripinna,* in which the production of the distal ends of the pinnule segments is sharp. I noted that the collections of the Indian Museum contained 30 specimens resembling my *O. pulchella* from Singapore, except that the production of the pinnule segments is sharp. Accordingly I described the supposed new form in manuscript as *Oligometra concinna.*

Upon reviewing the subject more carefully I found that this was at best only an average difference and that no definite line between *O. pulchella* and *O. concinna* could be drawn; furthermore, neither of them appeared to be separable from *O. serripinna* as redescribed by Hartlaub in 1891. Hartlaub's description of *O. serripinna,* it should be noted, was based on specimens of *O. caledoniae* from the Tonga Islands. I said that it seemed advisable to relegate both *Oligometra pulchella* and *O. concinna* to the synonymy of *O. serripinna.* Believing that a detailed description of typical Indian specimens might be of interest for comparison with the form from Singapore that I had called *pulchella,* I published my manuscript description of *Oligometra concinna,* which was based mainly upon an example from Puri but was comprehensive enough to include all the Indian specimens except that from the Pedro shoal, which has slightly more numerous cirrus segments. I remarked that the specimen from the Red Sea collected by the *Electra* in 20 fathoms which I had examined at the British Museum represents an apparently well-marked variety that I had called *electrae,* characterized by being exceptionally ornate, with extravagantly developed processes on the proximal pinnules. In the synonymy of *Oligometra serripinna* I included *Antedon cupulifera* (Lütken, MS.), which in reality refers to *O. caledoniae, Oligometra pulchella,* and *Antedon carinata* of Bell, 1894, under which name I had found a specimen from the Macclesfield Bank in the British Museum. In an appendix I recorded and gave notes upon additional specimens from off Gopalpore in 25–28 and 30–38 fathoms.

On August 8, 1913, I recorded a small specimen of *Oligometra serripinna* that had been collected in San Bernardino Strait by Captain Suensson. Later in 1913 Dr. August Reichensperger recorded and gave notes on 5 specimens of *Oligometra serripinna* from Nuhu Tawun, on the northern coast of Little Kei Island.

In 1915 Dr. Hubert Lyman Clark listed *Oligometra serripinna* as one of the echinoderms of Ceylon, referring as his authority to the author's memoir on the crinoids of the Indian Ocean published in 1912. In the same year I discussed the range of this species and its significance.

In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918, I recorded this species from stations 164 and 258 and gave notes on the specimens.

In 1921 in his memoir on the echinoderms of Torres Strait Dr. Hubert Lyman Clark under the heading *Oligometra carpenteri* said that Merton took five specimens in June 1908 on the northern coast of Little Kei Island. These five specimens are the ones that were correctly identified as *O. serripinna* and described by Reichensperger in 1913.

In 1929 I recorded and gave notes on two specimens that had been collected at Muhlos, Maldive Islands, by Prof. J. Stanley Gardiner, and in 1932 I recorded and gave notes on a specimen from Madras that had been collected in 1918 by Dr. Stanley Wells Kemp.

OLIGOMETRA SERRIPINNA var. MACROBRACHIUS A. H. Clark

Plate 27, Figures 141, 142

Oligometra serripinna (part) Reichensperger, Abh. Senck. Naturf. Ges., vol. 35, No. 1, 1913, p. 83 (Kei Islands), p. 105 (notes).

Oligometra serripinna var. *macrobrachius* A. H. Clark, Temminckia, vol. 1, 1936, p. 310 (characters; Ternate, 2–4 meters), pl. 9, figs. 10, 11.

Diagnostic features.—The arms are very long, up to 110 mm. in length; P_a is usually absent; and the outer cirrus segments usually bear paired dorsal tubercles instead of a transverse ridge.

Description.—The centrodorsal is a thin circular disk with the dorsal pole flat, 2.5 mm. in diameter. The cirrus sockets are arranged in a single regular marginal row.

The cirri are XV, 21–22 (usually 21), about 12 mm. long. The first segment is very short and those following gradually increase in length so that the two or three before the penultimate are only slightly broader than long. Most of the segments are about half again as broad as long. On the fourth segment the distal dorsal edge becomes prominent. On the segments succeeding this prominence slowly increases in height, moves slightly anteriorly, and becomes narrower, forming a low submedian transverse ridge; on the last five to seven segments before the antepenultimate this transverse ridge is represented by paired conical tubercles, and on the antepenultimate by a single median pointed tubercle. The opposing spine is prominent, conical, and erect, in height equal to about half the width of the penultimate segment. The terminal claw is longer than the penultimate segment and is strongly curved in the basal third, but becomes nearly straight distally.

The radials are low, 6–8 times as broad as long, and are separated interradially by a narrow notch. The IBr_1 are oblong, three times as broad as long, with the lateral edges straight and parallel. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long, with the parallel lateral edges about two-thirds as long as those of the IBr_1. The IBr series have a synarthrial tubercle which is very narrow and is continued basally to the proximal border of the IBr_1 in the form of a low rounded carination.

The 10 arms are 110 mm. in length, long, slowly tapering, and very slender. The first brachials are wedge-shaped, half again as long exteriorly as interiorly, interiorly united in the proximal two-thirds, the sides diverging at almost a right angle beyond the point of union. The second brachials are larger than the first, wedge-shaped, twice as long exteriorly as interiorly. The first syzygial pair (composed of brachials 3+4) is almost oblong, though slightly longer interiorly than exteriorly, slightly broader than long. The next four brachials are very slightly wedge-shaped, about three times as broad as the median length. On the brachials following the ends become more oblique, and after about the twelfth the brachials become practically triangular, about as long as broad, after the first quarter of the arm obliquely wedge-shaped, and terminally elongate. The first ten or twelve brachials are faintly subcarinate. The triangular and succeeding brachials have the distal edge slightly produced and armed with exceedingly fine spines.

P_1 is 5.5 mm. long with 14 segments, tapering rapidly on the first four segments and thence more gradually to the tip. The second and third segments are about as long as broad, and the sixth and following are about three times as long as broad. The eighth and following have their distal borders slightly everted and armed with fine spines. P_2 is 8.5 mm. long, much stouter basally than P_1 and tapering evenly and gradually to the tip; it is stiffened. It is composed of 16 segments of which the first is trapezoidal, about twice as broad as long, the second is very slightly longer than broad, and the fourth and following are about twice as long as broad. The fourth and following segments have the distal edge slightly everted and armed with fine spines which increase in prominence distally. P_3 is 5.5 mm. long with 12 segments. It is not much less stout basally than P_2, but it tapers much more rapidly. It is similar to P_2, but more slender distally. P_4 is 4 mm. long with 12 segments, similar to P_3 but tapering somewhat less rapidly and with the spines on the distal ends of the segments slightly more conspicuous. P_5 is similar to P_4, with 11 segments. The pinnules following are more slender in the distal portion, and the later pinnules increase in length. All the lower pinnules are more or less stiffened, as in *Decametra tigrina.*

Notes.—In the specimens from Vatek van Toeal in about 1–2 meters P_a may or may not be present. The cirrus segments vary from about as long as broad to twice as broad as long. P_2 is usually rather stout, but may be slender. The distal angles of the segments may be simply produced into a blunt process, or the entire distal border of the segments may be spiny.

The specimen from the Danish Expedition to the Kei Islands station 11 has the arms 115 mm. long.

The specimens from the Danish Expedition to the Kei Islands station 14 have the arms up to 105 mm. long.

In one of the two small specimens from the Danish Expedition to the Kei Islands station 18 the arms are 25 mm. long. P_1 and P_2 are present, but the next pinnule is on the twelfth or thirteenth brachial, with sometimes a very small one on the brachial preceding.

One of the specimens from the Danish Expedition to the Kei Islands station 31 has the arms 85 mm. long and the cirri X, 17–18. P_2 has 14 segments. The other three specimens are small.

The specimen from the Danish Expedition to the Kei Islands station 36 is very small.

The type specimen of this species is from the Danish Expedition to the Kei Islands station 38. In another specimen from this station the arms are 100 mm.

long. P_1 is 5.5 mm. long with 13 segments. P_2 is 12 mm. long with 20 segments. P_3 is 9 mm. long with 16 segments. P_4 resembles P_3. The pinnules following are slender and weak, 3.5 mm. long. On another arm P_1 is 7 mm. long with 15 segments. P_2 is 9 mm. long with 15 segments. P_3 is 8 mm. long with 14 segments. P_4 is about 6 mm. long. P_5 is about 5 mm. long, more slender than P_4. In this series of specimens the enlarged lower pinnules may be more or less prismatic with the spinous ends, especially at the angles, conspicuous. P_a is almost invariably absent, though exceptionally present.

One of the specimens from Amboina Bay has the cirri with 22–25 segments which in the proximal half are about twice as broad as long and in the distal half are about half again as broad as long. P_1 is 6.5 mm. long and tapers evenly and gradually from the base to the tip. It is composed of 15 segments of which the third is about as long as broad, the sixth is about twice as long as broad, and the six outermost are about three times as long as broad. P_2 is 10 mm. long, stouter than P_1 and tapering much more slowly. It is composed of 17 segments of which the third is about as long as broad and the sixth and following are about half again as long as broad. The distal segments have finely spinous distal ends, the spines being especially prominent at the angles. P_3 is 7.5 mm. long, resembling P_2 but tapering somewhat more in the outer half. It is composed of 16 segments. P_4 is 4.5 mm. long with 13 segments, resembling P_3 but proportionately smaller. P_5 is 4.5 mm. long with 13 segments tapering more rapidly than P_4 with more slender and more elongate segments distally, and weaker. The pinnules following resemble P_5.

In the eight specimens from Amboina P_a is only exceptionally present.

The largest specimens recorded by Reichensperger from Little Kei, with arms 105 mm. long, presumably are representatives of this form.

The four specimens from the pier at Ternate have the arms 110, 90, 90, and 30 mm. long. In one P_2 is practically smooth.

The two largest of the 12 specimens from Ternate in 2–4 meters have the arms 95 mm. long. In one specimen with the arms 85 mm. long the cirri are XV, 19; the transverse ridge on the outer segments is unmodified, or is more or less notched in the middle. In another specimen with the arms 85 mm. long the cirri are XIII, 17–19; the transverse ridge on the outer cirrus segments is unmodified. In a specimen with the arms 80 mm. long the cirri are XII, 18–19, none of the cirrus segments are quite so long as broad; the transverse ridges on the distal cirrus segments are usually 2-pointed; P_2 has 16–17 segments. In another specimen with the arms 80 mm. long the cirri are XIII, 17–19; the transverse ridges are unmodified; P_2 is almost smooth. In a third specimen with arms 80 mm. long the transverse ridges are unmodified; P_2 has 18–21 segments. In two other specimens with the arms 80 mm. long the transverse ridges are unmodified. In one of these P_2 has 18 or 21 segments, and is developed as usual. In the other P_2 is very slender with 17–20 segments of which the longest, the sixth and following, are half again as long as broad with the distal edges slightly produced and on the side toward the arm tips produced into a long, broad, distally curved spine.

Remarks.—This form differs from typical *serripinna* in being somewhat larger with longer arms, in lacking P_a (which sometimes is absent in typical *serripinna*), and in having the transverse ridge on the outer cirrus segments frequently, though not always, bilobed, 2-pointed, or replaced by a pair of tubercles. P_2 is usually large, broad, and much flattened; the segments have the distal edges prominent, and there are prominent processes at the distal ends of the prismatic ridges. Rarely P_2 is rather slender, flexible, and almost smooth, or with a long, broad, and sharp spine directed diagonally forward with the tip curved slightly distally, situated on the distal edge of the segments on the side toward the arm tip.

Although this form has certain features, such as the short cirrus segments of which the distal usually bear paired processes dorsally and the absence of P_a, which would appear to place it in the genus *Decametra*, the characteristic P_2 shows that it is really only an extreme variety of *Oligometra serripinna* which occurs with it, and with which it intergrades.

Localities.—Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Vatek van Toeal; about 2 meters; rocky coast; March 23, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Vatek van Toeal; about 1–2 meters; rocky coast; March 27, 1922 (23).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 11; 20 meters; sand; April 9, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 14; about 40 meters; sand; April 10, 1922 (7).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 18; about 40 meters; sand and coral; April 12, 1922 (2).

Danish Expedition to the Kei Islands, Dr. Th. Mortensen; station 31; about 50 meters; sand; April 19, 1922 (4).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 36; about 35 meters; sand; April 23, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 38; about 35 meters; sand, April 24, 1922 (9).

Danish Expedition to the Kei Islands, Dr. Th. Mortensen, Amboina Bay, about 50 meters, stones and sand, March 2, 1922 (2).

Nuhu Tawun, northern coast of Little Kei, Kei Islands, Dr. H. Merton, June 16, 1908 [Reichensperger, 1913].

Ternate; pier, 4 meters; *Willebrord Snellius,* April 1, 1930 [A. H. Clark, 1936] (4, L. M.).

Ternate; 2–4 meters; *Willebrord Snellius,* June 6, 1930 [A. H. Clark, 1936] (12, L. M.).

Geographical range.—Only known from the Kei Islands, Ternate, and Amboina.

Bathymetrical range.—From the shore line down to 50 meters.

History.—The exceptionally large specimens of *Oligometra serripinna* from the Kei Islands mentioned by Reichensperger in 1913 undoubtedly represent this form. I first met with it when studying the crinoids collected by Dr. Th. Mortensen at the Kei Islands in 1922. It was at that time described in manuscript as *Decametra macrobrachius,* which was assumed to be a form intermediate between *Decametra* and *Oligometra.* It was again found in the collections of the Dutch steamer *Willebrord Snellius,* and after further study was described in 1936 as *Oligometra serripinna* var. *macrobrachius.*

OLIGOMETRA SERRIPINNA var. IMBRICATA A. H. Clark

PLATE 28, FIGURES 145–147

[See also vol. 1, pt. 2, figs. 492, 493 (pinnule tip), p. 273.]

Oligometra imbricata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 228 (description. ?Tranquebar); vol. 22, 1909, p. 7 (listed), p. 42 (compared with *O.* [*Decametra*] *studeri*); Vid; Medd. Naturh. Foren. København, 1909, p. 180 (?Tranquebar; includes *cupuliferus*, var., compared with *serripinna*); Crinoids of the Indian Ocean, 1912, p. 168 (synonymy; Ganjam coast, 24–30 fms.; ?India; also ?Tranquebar), fig. 27, p. 170; Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (in key; range).

Antedon cupuliferus, var. (Lütken, MS.) A. H. CLARK, Vid. Medd. Naturh. Foren. København; 1909, p. 117 (synonym of *O. imbricata*).

Diagnostic features.—The distal ends of the brachials in the proximal third of the arm are much produced and are turned abruptly outward; the segments of P_2 usually have slightly developed lateral processes.

Description.—The centrodorsal is rather large, discoidal, with a large concave polar area. The cirrus sockets are arranged in a single marginal row.

The cirri are XVI–XVII, 23–28 (usually 24–26), about 12 mm. long. All of the segments except the terminal 5 or 6, which are about as long as broad, are broader than long, the basal very much so. The segments are flattened dorsally; basally they have prominent distal dorsal ends which show a tendency to rise into a low transverse ridge which in the outer part of the cirri becomes more distinct and gradually narrower, at the same time gaining in height so that the terminal 6 or 7 segments have minute median dorsal spines. The opposing spine is prominent, but slender, in length not reaching quite the width of the penultimate segment. The terminal claw is longer than the penultimate segment, strongly curved basally but becoming nearly straight distally.

The distal ends of the radials are even with the rim of the centrodorsal. The IBr series and brachials have about the same proportions as those of *O. serripinna*, and the synarthrial tubercles are about as prominent as in that species. The brachials differ, however, in having very strongly produced and overlapping distal edges.

The arms are about 45 mm. long.

P_2 is much longer and stouter than P_1. The following pinnules decrease rapidly in size, remain uniform for some time, then slowly increase distally. The basal segments of the lower pinnules may be more or less carinate, and the distal segments expand somewhat from the proximal to the distal end, giving the edge of the pinnules a serrated outline.

The color in alcohol is grayish brown, the perisome darker.

Remarks.—Although the strongly produced distal ends of the brachials in the earlier portion of the arms give this form a very distinctive appearance, it is probably only a variety of *O. serripinna. Oligometra serripinna* occurs on the Ganjam coast and at Ceylon, and individuals from various parts of its range sometimes show, more or less developed, the feature characteristic of *imbricata*.

Notes.—In 1909 I wrote that in the original description of this species I had confined myself to an exposition of only the most essential characters, as the subjection of the two specimens to a more detailed examination would involve a very considerable risk owing to their poor state of preservation.

In the specimens from the Ganjam coast of India the lower pinnules are strongly serrate.

Localities.—?Tranquebar, just north of Karikal, southeastern India [A. H. Clark, 1908, 1909, 1912, 1918] (2, C. M.).

Bengal Fisheries steamer *Golden Crown;* Ganjam coast, Madras Presidency; 44–55 meters [A. H. Clark, 1912] (2, U.S.N.M., 35339; I. M.).

?India (probably Ceylon) [A. H. Clark, 1912] (1, I. M.).

Geographical range.—Eastern coast of India.

Bathymetrical range.—From the shore line down to 44 (?55) meters.

History.—This variety was originally described by me in 1908 as *Oligometra imbricata* from two specimens in the Copenhagen Museum from ?Tranquebar that had been labeled *Antedon cupuliferus* var. by Prof. C. F. Lütken. In a paper on the crinoids of the Copenhagen Museum published in 1909 I said that Dr. Clemens Hartlaub had identified as *Oligometra serripinna* specimens of Lütken's *Antedon cupuliferus* that I had found in the Hamburg Museum (see under *Oligometra caledoniae*, p. 241), so that I had thought it best not to use Lütken's name as the specific designation of this form as it might cause confusion. In my memoir on the crinoids of the Indian Ocean published in 1912 I figured a typical specimen of *O. imbricata* and recorded two specimens from the Ganjam coast of Indian in 24–30 fathoms, and one from ?India. In the key to the species of *Oligometra* published in my report on the unstalked crinoids of the *Siboga* expedition in 1918, I included *imbricata*, giving as the locality ?Tranquebar, India.

OLIGOMETRA SERRIPINNA var. ERINACEA A. H. Clark

PLATE 28, FIGURES 148, 149

Oligometra serripinna var. *erinacea* A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 323 (1 specimen in the type series lacks P_a on both arms of 1 ray), p. 324 (detailed description and comparisons; locality).

Oligometra erinacea A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (in key; range).

Diagnostic features.—The distal edges of the brachials in the proximal third of the arm are turned abruptly outward and greatly produced, with a scalloped and irregular crest; proximal to the second syzygy this eversion becomes restricted to the central portion of the distal edge and may be more or less resolved into high tubercles or blunt spines; the anterior angle of the axillary is usually produced dorsalward or bears three prominent tubercles; the lateral processes of the segments of P_2 are high and broad, usually with a truncated distal angle.

Description.—The centrodorsal resembles that of *O. serripinna*. It is thin discoidal, 2 mm. in diameter, with the dorsal pole flat, usually with a raised rim.

The cirri are XV–XVII, 21–24 (usually 23), from 10 to 12 mm. long. They are a trifle more slender than the cirri of *O. serripinna*, and usually have a slight, though perceptible, distal taper after the proximal half. The segments are all short, most of them about half again as broad as long, not becoming as long as broad until the second or third before the penultimate. The dorsal processes resemble those of the cirri of *O. serripinna*, but the transverse ridge toward the middle of the cirri shows a more or less marked division into two halves accompanied by a more or less deep and angular notch in the crest, and in the outer part resolves itself into two laterally elongate tubercles placed side by side.

The structure of the arm bases and of the arms is in general the same as that of *O. serripinna.* The synarthrial tubercles on the articulations between the elements of the IBr series and first two brachials are enormously developed, as in *Perometra diomedeae* or in *Amphimetra ensifer,* but their apices, though they may be smooth as in those species, are usually blunted and spread out laterally, bifurcated, or armed with several blunt spines. Each half—proximal and distal—of the synarthrial tubercle may be at the tip armed with a sharp tubercle, the two tubercles pointing away from each other at a considerable angle, or the proximal half of the synarthrial tubercle may distally be laterally spread out and fanlike or dentate, and the distal half almost or quite unmodified. The synarthrial tubercle on the articulation between the first two brachials as a rule departs more widely from the normal than that on the articulation between the elements of the IBr series. The IBr axillary has a usually very long and prominent tubercle on either side of the distal apex.

The second and following brachials have the distal edge everted, standing out at right angles to the dorsal surface as a very high finely spinous crest. On the earlier segments this crest is laterally narrow so that it appears as a high tubercle which may be slightly broadened or chisel-shaped at the tip, or may be bifurcate or coarsely dentate. After the first syzygy this process gradually broadens laterally so that after the second syzygy it comes to involve the entire distal border of the brachials, which stand out as very high more or less irregularly scalloped or dentate finely spinous vertical frills. The earlier narrow projections are usually divided up into a few large tubercles, but the broad later ridges are more uniform and more regular.

The pinnules in general resemble those of *O. serripinna,* but they are very much more ornate. P_1 is 5 mm. long, very slender, with 14 segments of which the distal are considerably elongated, and the outermost 5 or 6 have high carinate processes involving the distal third or half of the median dorsal line. P_2 is 7 mm. long with 14 segments which in the distal portion are rather longer than is usual in *O. serripinna.* The processes in the middorsal line are much longer and larger than in *O. serripinna,* after the first 4 or 5 segments being a high uniform carination of the whole outer edge of the segment of which the crest is parallel with the longitudinal axis of the pinnule, and in the outermost 6 or 7 bifurcated, although not involving so much of the segments. The ventrolateral edges of the segments are as in *O. serripinna.* The pinnules following have the distal edges of the segments beyond the second greatly produced, especially in the middorsal line, this production in lateral view appearing like long overlapping spines such as are seen in the distal parts of the arms of the species of *Asterometra* or of *Stylometra.* The distal pinnules, so far as they are preserved, do not appear to differ in any way from those of *O. serripinna.*

The size is the same as that of *O. serripinna.*

Notes.—One of the 18 specimens from which the preceding description was drawn up lacks P_a on both the arms arising from one of the IBr axillaries.

Locality.—*Investigator* station 171; entrance to Palk Strait; Point Pedro, Ceylon, bearing SSE, about 3 miles distant; 9–13 (or 11–15) meters; sand; March 23, 1894 [A. H. Clark, 1912, 1918] (18, U.S.N.M., 35319; I. M.).

History.—This species was described by me under the name *Oligometra serripinna* var. *erinacea* in an appendix to my memoir on the crinoids of the Indian Ocean published in 1912. In my report on the crinoids of the *Siboga* expedition published in 1918, I included *erinacea* in the key to the species of *Oligometra*, giving northeastern Ceylon as the habitat.

OLIGOMETRA SERRIPINNA var. OCCIDENTALIS A. H. Clark

PLATE 26, FIGURE 136; PLATE 28, FIGURES 150, 151; PLATE 30, FIGURE 163

Oligometra serripinna var. *occidentalis* A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 3 (synonymy; Mauritius; Cargados Carajos; 0–30 fms.; characters); vol. 43, 1912, p. 384; Crinoids of the Indian Ocean, 1912, p. 174 (synonymy; localities); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 90 (*Mabahiss* stations 10, 27, 45; notes; range), p. 101.

Oligometra occidentalis A. H. CLARK, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (resembles specimens of *serripinna* from Tonga; distribution of this type); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 382 (cotype from Bagamoyo in U. S. N. M.); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 38 (published reference to specimens in the B. M.; locality; notes); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (in key; range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 87 (listed), p. 104.

Oligometra serripinna occidentalis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 401 (Fouquet Island, near Mauritius; Bagamoyo).—HARTMEYER, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (Fouquet Island, No. 5101; specimen from Bagamoyo in U. S. N. M.).

Diagnostic features.—The segments of the pinnules following P_2 have rather strongly projecting distal edges and angles; the lateral processes on the distal ends of the outer segments of P_2 are only slightly developed.

Description.—The cirri are XIV–XVII, 18–22 (usually 19–20). The distal segments are about as long as broad.

The 10 arms are 70–80 mm. long.

P_2 is much larger than P_1 or P_3 and is composed of 19 segments most of which are about as long as broad, or slightly longer than broad. The lateral processes on the distal ends of the outer segments are only slightly developed, and are small and delicate. The segments of the pinnules succeeding P_2 have rather strongly projecting distal edges and angles.

Notes.—The preceding description is based upon the nine specimens from Cargados Carajos.

In the specimen from Mauritius the cirri are XVI, 17, 9 mm. long. The arms are about 55 mm. long. P_2 is 7 mm. long with about 15 segments. The lower pinnules exhibit almost none of the peculiar expansion of the distal ends of the segments from which *serripinna* gets its name, there being merely a small process ending in a tuft of very fine spines at the three distal angles.

Both the specimens from *Mabahiss* station 45 are small, and in both P_a is absent One of them has the arms 25 mm. long.

One of the specimens from *Mabahiss* station 27 has the arms 55 mm. long and the cirri XIV, 14–15. P_2 has 13 segments of which the outer have the prismatic angles very slightly produced. The other specimen from station 27 has the arms 50 mm. long and the cirri XI, 13–14. P_2 has 12 segments, the outer with a very slight production of the prismatic angles.

The specimen from *Mabahiss* station 10 consists of arm fragments from a large individual.

Remarks.—The characteristic feature of this form is the very slight development of the processes on the distal ends of the segments of the lower pinnules. This character, however, is very variable, and the specimens mentioned above may be matched fairly well with some from Singapore in the collection of the Copenhagen Museum, and with some from India in the collection of the Indian Museum. The cirri are proportionately slightly longer than is usual in *serripinna,* but in this feature also it may be matched by specimens from India and Singapore.

The specimen from Bagamoyo, which I have previously referred to this form, seems on reexamination to be more properly referable to typical *serripinna* (see pages 217 and 229).

Localities.—Fouquet Island, near Mauritius; Prof. Karl Möbius [A. H. Clark, 1911, 1912, 1918; Hartmeyer, 1916] (1, Berl. M., 5101).

Cargados Carajos, northeast of Mauritius; 55 meters; *Sea Lark;* Prof. J. Stanley Gardiner [A. H. Clark, 1911, 1913, 1918] (9, B. M.).

Mabahiss station 45; South Arabian coast (lat. 18°03′30″ N., long 57°02′30″ E.); 38 meters; lithothamnion; October 29, 1933 [A. H. Clark, 1936] (2, B. M.).

Mabahiss station 27, Gulf of Aden (lat. 11°57′12″ N., long. 50°35′00″ E. to lat. 11°56′42″ N., long 50°39′12″ E.); 37 meters, sand and shells, October 12, 1933 [A. H. Clark, 1936] (2, B. M.).

Mabahiss station 10; Red Sea (lat. 13°31′00″ N., long 42°31′00″ E.); 55 meters; September 17, 1933 [A. H. Clark, 1936] (fragments, B. M.).

Geographical range.—From Mauritius and Cargados Carajos to the Red Sea.

Bathymetrical range.—From the shore line down to 55 meters.

History.—This form was first mentioned under the name *Oligometra serripinna* var. *occidentalis* in a paper by me on the crinoids of the coasts of Africa published in 1911. Notes were given on a specimen from Mauritius and on nine specimens from Cargados Carajos, and the specimen from Mauritius was compared with specimens of *O. serripinna* from Singapore. In a paper on the crinoids of the Berlin Museum published in 1912 I recorded a specimen under the name *Oligometra serripinna occidentalis* that had been collected by Prof. Karl Möbius at Fouquet Island, near Mauritius, and another from Bagamoyo. The specimen from Fouquet Island was the one mentioned as from Mauritius in 1911. In a paper on the crinoids of the British Museum published in 1913, I gave notes on nine specimens that had been collected by the *Sea Lark* expedition under Prof. J. Stanley Gardiner at Cargados Carajos in 30 fathoms, the form being here called *Oligometra occidentalis.* These were the specimens mentioned as from Cargados Carajos in 1911.

In 1916 Dr. Robert Hartmeyer under the name *Oligometra serripinna occidentalis* gave the catalog number of the specimen in the Berlin Museum from Fouquet Island and said that the specimen from Bagamoyo was in the United States National Museum.

In my report on the crinoids of the *Siboga* expedition published in 1918, I included *occidentalis* in the key to the species of *Oligometra,* giving as the habitat southeastern Africa and Cargados Carajos.

OLIGOMETRA SERRIPINNA var. ELECTRAE A. H. Clark

Oligometra serripinna var. *electrae* A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 51 (locality; *nomen nudum*); Crinoids of the Indian Ocean, 1912, p. 174 (synonymy; locality); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 101 (range).

Oligometra electrae A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 38 (locality; characters); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 129 (in key; range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 104.

Characters.—This is an exceptionally ornate form with extravagantly developed processes on the proximal pinnules.

Locality.—Red Sea, southeast of Messawa, Eritrea (lat. 15°02′30″ N., long. 41°13′30″ E.); 36 meters; cable repair ship *Electra* [A. H. Clark, 1911, 1912, 1913, 1918] (1, B. M.).

History.—This variety was first mentioned as *Oligometra serripinna* var. *electrae* (*nomen nudum*) in a paper on the recent crinoids of the coasts of Africa published by me in 1911, and also in my memoir on the crinoids of the Indian Ocean published in 1912. In both places the locality was given. Under the name *Oligometra electrae* it was briefly characterized by me in a paper on the crinoids of the British Museum published in 1913. In my report on the crinoids of the *Siboga* expedition published in 1918 I inserted *electrae* in the key to the species of *Oligometra*, giving the Red Sea as the habitat.

OLIGOMETRA SERRIPINNA CALEDONIAE A. H. Clark

Antedon serripinna Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 82 (Tonga Islands; detailed description of the specimens), p. 113 (in Göttingen Mus.), pl. 5, fig. 48.

Antedon cupulifera (Lütken, MS.) Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 82 (name found with specimens from Tonga).—A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 179 (in synonymy of *O. serripinna*); Crinoids of the Indian Ocean, 1912, p. 170 (in synonymy of *O. serripinna*).

Oligometra caledoniae A. H. Clark, Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 254 (description; New Caledonia); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (New Caledonia; discussion of this and similar varieties of *O. serripinna*); Crinoids of the Indian Ocean, 1912, p. 175 (New Caledonia; description); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 39 (no locality; Prof. J. B. Jukes); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 130 (in key; New Caledonia and the Tonga Islands).

Oligometra serripinna (part) A. H. Clark, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 27 (Tonga Islands; description of specimens and comparisons); Crinoids of the Indian Ocean, 1912, p. 172 (Tonga Islands.).

Diagnostic features.—The segments of P_2 have only a very slight spinous production of the distal ends, which may be obsolescent; the distal ends of the pinnules following P_2 are not produced.

Description.—The cirri are XI, 18–19, very short, rather stout, resembling those of *O. serripinna.* The first segment is about twice as long as broad and those following very gradually increase in length so that the eleventh to thirteenth and following are about as long as broad. On the fifth the distal dorsal edge becomes slightly everted, this eversion on the twelfth and following becoming a median transverse ridge that appears as a minute spine in lateral view. The opposing spine is prominent, median, and erect.

The 10 arms are 83 mm. long and resemble those of *O. serripinna.*

P_1 is slender, flagellate distally, with 21 segments which at first are short, becoming about as broad as long on the fifth, the remainder being slightly longer than broad.

P_2 is half again as long as P_1 and proportionately stouter with 21 or 22 segments of which the longest are only slightly longer than broad. P_3 and the following pinnules are shorter and more slender than P_1. P_3 has 14 or 15 segments. The distal pinnules are long and slender with from 32 to 36 segments.

Notes.—Under the name *Antedon serripinna* Dr. Clemens Hartlaub described 9 specimens from the Tonga Islands in the following terms:

The centrodorsal is flat discoidal with a smooth, sometimes slightly concave, dorsal pole. The cirri are arranged in a single marginal row. The cirri are about XX, about 20, about 11 mm. long. The segments are approximately equal with a broad dorsal surface, and almost all of them are broader than long. In the proximal half of the cirri the distal ends of the segments overlap the bases of those succeeding. The dorsal side of the distal segments bears a very slight transverse ridge. The opposing spine is sometimes only feebly developed. The radials are only slightly visible in the interradial angles of the calyx. The IBr_1 are very short, laterally free or in loose contact. The IBr_2 (axillaries) are short, pentagonal or almost triangular. A small synarthrial tubercle is developed on the articulation between the elements of the IBr series.

The 10 arms, which are up to 60 mm. in length, have an uneven dorsal surface. The first brachials are rather short, and are laterally united interiorly. The second are of about the same size, and are somewhat longer exteriorly than interiorly. The first syzygial pair (composed of brachials 3+4) is larger than the second brachials, and is longer interiorly than exteriorly. Following the first syzygial pair there are a few short discoidal brachials, and then a long row of rather short triangular ones. The triangular brachials have markedly produced distal ends that overlap on alternate sides the succeeding brachials. Also, the articulation between the first two brachials is not smooth. The brachials remain wedge-shaped almost to the arm tips; here they become blunter, and finally more oblong. There is a small synarthrial tubercle on the union between the first two brachials. The first syzygy is between brachials 3+4. The position of the second is individually somewhat variable; it is commonly about brachials 9+10, but may be between brachials 13+14. The distal intersyzygial interval in some specimens is 3 or 4, but in others 6 or 7 muscular articulations.

In the proximal portion of the arms the distal ends of the pinnule segments tend to overlap the basis of the segments succeeding. On the pinnules of the first pair (P_1 and P_a) this is only slightly evident. P_1 is about 4 mm. long. P_a is markedly smaller. The longest and stoutest pinnules are P_2 and P_b. P_2 measures 6 mm. in length and is composed of about 14 rather short segments. P_3 and P_4 are markedly smaller than P_2, and are of about the same length. The pinnules immediately succeeding are the shortest. The following pinnules reach a length of 7 mm. The basal segments of the proximal pinnules are rather strongly broadened, and in the other pinnules in the earlier portion of the arms also the second and third segments tend to be especially large. The disk is not preserved. Sacculi are closely set on the pinnules.

The color in alcohol is light brown with dark bands and spots on the brachial articulations. The centrodorsal and the cirri are uniform light brown.

Hartlaub said that these specimens differ from the type specimen from Andai, New Guinea, in the Leyden Museum in having a larger number of cirri and a different coloration. The type specimen has only XII cirri and a white ground color with dark red-brown bands on the arms. The general color of the specimens from Tonga is, on the contrary, very dark because the deeply colored bands and spots on the brachials balance the lighter brown ground color. The specimens from Tonga are larger, as the arms of the type specimen are only 30 mm. long.

I examined 7 of these specimens at the Hamburg Museum in 1910. In one of them the cirri are XXIII, 21, the segments terminally becoming nearly as long as broad. The centrodorsal is thin discoidal, with the cirrus sockets, which are oblong and from two and one-half to three times as high as broad, arranged in a single regular marginal row; the dorsal pole is slightly concave, 3 mm. in diameter. P_2 is 7 mm. long with 15 segments of which the fifth is the longest, twice as long as broad, there is a very slight spinous production of the distal ends of the segments.

Another specimen has also 21 cirrus segments which distally are nearly as long as broad. P_2 has 15–18 segments of which the basal are flattened exteriorly; the distal edges of the third and following segments are slightly produced and spinous.

In a third specimen the arms are about 60 mm. long. The cirri are 15 mm. long with 20 or 21 segments. P_1 has 10–13 segments. P_2 has 12 segments which have no perceptible production of the distal edges.

A fourth specimen is interesting in possessing 11 arms, one IIBr series consisting of a single axillary ossicle being present. P_1 has 16 segments.

The three remaining specimens are similar to those described.

I wrote that these specimens possess in general the characters of the form from southeastern Africa, which I called *occidentalis*, and possibly should be recorded under that name. They have but the merest trace of the character from which *serripinna* gets its name, though this is not entirely absent.

In a specimen from Tonga in the Copenhagen Museum (labeled by Lütken *Antedon cupuliferus*) P_2 is practically smooth—there are no easily visible spines on the distal ends of the segments.

Abnormal specimen.—One of the specimens from the Tonga Islands in the Hamburg Museum has 11 arms, a single IIBr series consisting of a single axillary ossicle being present.

Localities.—New Caledonia; M. Vigué, 1875 [A. H. Clark, 1911, 1912, 1913, 1918] (1, P. M.).

Tonga Islands, from the Godeffroy Museum collection [Hartlaub, 1891; A. H. Clark, 1912] (7, H. M.).

Tonga Islands, from the Godeffroy Museum collection (1, C. M.).

No locality, Prof. J. Beete Jukes; H. M. S. *Fly*, 1843–1847 [A. H. Clark, 1913] (1, B. M.).

Geographical range.—From New Caledonia to the Tonga Islands.

Bathymetrical range.—Littoral.

History.—Under the name *Antedon serripinna* Dr. Clemens Hartlaub in 1891 described in detail 9 specimens from the Tonga Islands which he had found in the Hamburg Museum bearing Lütken's manuscript name *Antedon cupulifera.* They had originally been a part of the collection of the Godeffroy Museum. He gave a figure of the central portion of one of the specimens viewed dorsally, and compared his material with the type of Carpenter's *Antedon serripinna*, and with his new *A. japonica* (=*Iconometra japonica*).

In my paper on the crinoids of the Copenhagen Museum published in 1909, I included *Antedon cupulifera* in the synonymy of *Oligometra serripinna*. In a paper on the crinoids of the Paris Museum published in 1911 I described *Oligometra caledoniae* on the basis of a single specimen that had been collected in New Caledonia by M. Vigué in 1875. In a paper on the crinoids of the Hamburg Museum published in 1912, I redescribed 7 of the specimens from the Tonga Islands that had been discussed by Hartlaub in 1891, and compared them with *O. occidentalis*, *O. serripinna*, and *O. japonica*. In my memoir on the crinoids of the Indian Ocean published later in 1912, I included *Antedon cupulifera* in the synonymy of *Oligometra serripinna*, and gave the Tonga Islands as among the localities for the latter. In a paper on the crinoids of the British Museum published in 1913 I recorded a specimen of *Oligometra caledoniae* without locality that had been collected by Prof. J. Beete Jukes. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918, I included *caledoniae* in the key to the species of the genus *Oligometra*, giving as the range New Caledonia and the Tonga Islands. This is the only intimation that the specimens from these two localities were considered conspecific.

OLIGOMETRA SERRIPINNA CHINENSIS A. H. Clark

PLATE 27, FIGURE 144; PLATE 28, FIGURE 152

Oligometra serripinna A. H. CLARK, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 27 (in part; Fuchow; characters); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (Fuchow).

Oligometra chinensis A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 130 (in key; range).—GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, p. 283.—G. A. SMITH, Ann. Mag. Nat. Hist., ser. 9, vol. 20, No. 117, 1927, p. 272 (Fukien).—GISLÉN, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 29 (comparison with *Prometra* [*Decametra*] *perplexa*).

Diagnostic features.—P_2 is not greatly enlarged, becoming delicate distally, with the distal segments twice as long as broad or even longer, the profile serrate in the distal half; the second-fourth segments of the lower pinnules are narrowly carinate; the cirri are relatively long and slender with up to 24 segments.

Description.—The centrodorsal is thin discoidal with a flat dorsal pole having a somewhat irregular surface. The cirri are arranged in two closely crowded alternating marginal rows.

The cirri are XXIII, 20–21, up to 8 mm. long. In the fully developed peripheral cirri the first four segments are very short, about four times as broad as long, and those following slowly increase in length so that the outermost are usually about as long as broad, though they vary from slightly broader than long to slightly longer than broad. The ventral surface of the cirri is rather abruptly arched in the proximal portion, becoming more regularly arched in the distal half. Ventrally the distal ends of the segments are slightly produced, this being especially noticeable in the proximal third of the cirri and diminishing distally, finally almost or quite disappearing. Viewed dorsally the cirri are seen to taper more rapidly in the proximal third than distally, and the dorsal surface in the earlier broadened portion is strongly flattened. Dorsally the distal ends of the third or fourth and following segments are produced, this production after the proximal third moving slowly proximally and becoming an arcuate finely spir ous transverse ridge. Moving still further proximally and narrowing, this transverse ridge finally, on from one to three segments before the penultimate, becomes reduced to a small sharp median tubercle. The opposing spine is large, sharp, and erect, triangular in lateral view, arising from almost the entire dorsal surface of the penultimate segment, and in height equal to from one-third to one-half the width of that segment. The terminal claw is longer than the penultimate segment and is stout, sharply pointed, and strongly curved, sometimes more strongly curved in the proximal third or half than distally. The smallest cirri immediately about the dorsal pole of the centrodorsal are much shorter than the peripheral cirri, only about one-third as long, and much more slender. They are composed of 9–12 segments which become half again as long as broad distally. The segments are somewhat constricted centrally with prominent ends, and the dorsal processes are very slight or even entirely absent.

The radials are short, from 8 to 10 times as broad as long in the median line, with the distal edge slightly concave and the lateral edges free. The IBr_1 are short, about three times as broad as long, approximately oblong but with the proximal border slightly convex. There is a small ventrolateral tubercle in the middle or in the distal half of the lateral borders. The IBr_2 (axillaries) are short, twice as broad as long, triangular with the lateral angles broadly truncated so that the lateral sides are about half as long as the sides of the IBr_1, or shorter. These lateral sides are produced into a slight flangelike process. There is a low and broad synarthrial tubercle occupying the proximal third or half of the midline of the IBr_2 and the entire midline of the IBr_1 on which it diminishes in height proximally.

The 10 arms are 40 mm. long. The first brachials are wedge-shaped, about twice as long exteriorly as interiorly. Their interior sides are usually united for the proximal half, the distal halves diverging at approximately a right angle. The exterior sides are produced into a usually narrow flange the outer edge of which is straight. The second brachials are of about the same size as the first, but are more obliquely wedge-shaped. The first syzygial pair (composed of brachials 3+4) is longer interiorly than exteriorly, and is about twice as broad as the median length. The epizygal is approximately oblong, and the hypozygal is wedge-shaped. The next four brachials are oblong or very slightly wedge-shaped, about four times as broad as the median length. After the second syzygy the brachials are very obliquely wedge-shaped, almost triangular, half again as broad as long, with strongly produced, slightly everted, finely spinous distal ends. After the proximal third of the arm the brachials lose the strong eversion of the distal ends and become slowly and gradually longer so that the distal brachials are about as long as broad and the terminal are longer than broad.

Syzygies occur between brachials 3+4, 9+10, and 14+15, distally at intervals of 4 and subterminally at intervals of 5+7 muscular articulations.

P_1 is 3.3 mm. long with 13 segments and tapers from a moderately stout base to a delicate tip. It is rather strongly prismatic, though the prismatic ridge is rounded. The first segment is short, the third is about as long as broad, and the distal are about twice as long as broad, becoming longer subterminally. The second-fourth segments are strongly carinate, the carinate processes being highest on the second and third. The segments in the distal half have very finely spinous distal ends, but these are not conspicuous. P_2 is 3.8 mm. long, slightly stouter than P_1 basally and, like it, tapering gradually to the tip. It is composed of 13 segments of which the first is almost triangular, half again as broad as long, the second is twice as broad as long, the third is about as long as broad, and the distal are about twice as long as broad or slightly longer. The pinnule is roundedly prismatic. The second–fourth segments are slightly carinate, but less strongly so than the corresponding segments of P_1. The longer outer segments have the distal ends armed with fine spines along the end of the broad prismatic crest, but these spines are not conspicuous. In general this pinnule is but slightly enlarged and appears almost rounded and practically smooth. P_3 is about as long as P_1, and is shorter, less stout, and distally more flexible than P_2. The second and third segments of this and three or four of the pinnules immediately succeeding are slightly carinate.

The arms as far as the second syzygy are purple with a broad brownish-yellow median band, from that point onward brownish yellow with two or three broad and widely spaced purple bands. The cirri are brownish yellow.

The specimen described is that from Amoy collected by Dr. T. Y. Chen (U. S. N. M., E. 3100).

Notes.—In the specimen from Fuchow there are 23–24 cirrus segments which become nearly as long as broad distally. P_2 is 7 mm. long with 18 segments that possess only a slight trace of lateral processes. The second–fourth segments of the earlier pinnules are carinate.

Localities.—Fuchow, Province of Fukien (Fokien), China; Consul S. Siemssen, December 18, 1905 [A. H. Clark, 1912, 1913] (1, H. M.).

Amoy, Province of Fukien, China (lat. 24° 28′ N., long. 118° 08′ E.); Dr. T. Y. Chen (1, U. S. N. M., E. 3100).

Amoy; Prof. C. Ping, 1924 (4, B. M.).

Province of Fukien, China; Prof. C. Ping [G. A. Smith, 1927] (4, B. M.).

Geographical range.—Known only from the coast of the Province of Fukien, China.

Bathymetrical range.—Littoral.

History.—In a paper on the crinoids of the Hamburg Museum published in 1912, I recorded and gave notes on a specimen from Fuchow which I referred to *Oligometra serripinna*. In a list of the crinoids known from between Cochin China and Korea (Chosen) published in 1913, I included *Oligometra serripinna* from Fuchow, the specimen referred to being that in the Hamburg Museum. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918, I included the new name *chinensis* in the key to the species of the genus *Oligometra*, with the locality Fuchow, China. The characters of *chinensis* were taken from my notes on the specimen from Fuchow in the Hamburg Museum.

In 1927, George Alexander Smith recorded *Oligometra chinensis* from Fukien. This record was based upon specimens that had been presented to the British Museum, together with some other echinoderms, by Prof. C. Ping of the University of Amoy. As Mr. Smith said, these specimens had been sent to me for determination.

Genus CLARKOMETRA Gislén

Clarkometra Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 7 (relationships), pp. 10, 142 (characters; genotype *C. elegans*); Zool. Bidrag Uppsala, vol. 9, 1924, p. 54 (influence of absence of lower pinnules), p. 212 (pinnule gap), fig. 84, p. 81 (syzygial face); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18; Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 15.

Diagnosis.—A genus of Colobometridae including small and delicate species with 10 arms 12–35 mm. long; P_1 and P_a are absent; and the cirri are composed of 12–19 segments which bear dorsally a curved transverse ridge, becoming outwardly a single median tubercle.

Geographical range.—From southwestern Mindanao to the Bonin Islands.

Bathymetrical range.—From 72 to 80 meters.

Remarks.—Dr. Gislén placed this genus in the subfamily Perometrinae of the family Antedonidae. But the transverse ridge on the cirrus segments, the stout cirri composed of segments most of which are about as long as broad, and the general structure seem to me to place it in the family Colobometridae. The features resembling more or less closely those characteristic of the Perometrinae are in my opinion due simply to the small size. *Clarkometra elegans* resembles the small species of the genera *Decametra* and *Prometra* much more closely than it does any of the species included in the subfamily Perometrinae.

Gislén said that in all morphological characteristics *Clarkometra* proves to be a macrophreate type and is to be included in the subfamily Perometrinae. But he noted the fact that the dorsal prominence on the fifth-eighth cirrus segments is a transversely curved even crest and remarked that this reminds one of the condition in the family Colobometridae where, however, the crest is always forked or serrate. He wrote that *Clarkometra* agrees with the genus *Hypalometra* in the absence of P_1 and P_a, but differs from it in the low flattened centrodorsal, the short cirri which are composed of a rather small number of approximately squarish segments, and in the occurrence of two pairs of oral pinnules. Of the other distinguishing marks he said he ought, perhaps, to mention the appearance of the cirrus sockets on the centrodorsal. The perforation for the central canal is situated in the middle of a relatively large calcareous wart located in the central part of the cavity in which the cirrus is fixed.

CLARKOMETRA ELEGANS Gislén

Plate 26, Figures 137, 138

Clarkometra elegans Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 5 (127–163 m.), p. 6 (Bonin Islands), p. 143 (descriptions of 17 specimens; Bock's stations 43, 53), pp. 182, 183 (listed), figs. 141–149, p. 146, pl. 1, fig. 8; Zool. Bidrag Uppsala, vol. 9, 1924, p. 39, footnote (disk reaches to brachials 3+4), p. 42 (brachial angles), p. 44 (reversion), pp. 46, 47, 51 (obliquity of joint faces), p. 53 (axillary angle), p. 82 (syzygies), fig. 10, p. 45 (arm base), figs. 30–32, p. 52, fig. 84, p. 81.—A. H. Clark, Temminckia, vol. 1, 1936, p. 295 (listed), p. 310 (*Willebrord Snellius* station 60*; notes).

Description.—The centrodorsal is low and convex, 1.8 mm. broad and 1 mm. high from the radials to the dorsal pole, with the bare dorsal surface 1 mm. in diameter and somewhat granulated. The cirri are arranged in two crowded alternating rows.

The cirri are XXX, 15–18, from 3.5 to 5 mm. long. The first segment is broader than long, the second and third are about as long as broad, and the fourth is one-quarter again as long as broad. The segments succeeding decrease in length. The fifth-seventh or eighth segments have a low curved transverse ridge which beyond the eighth contracts to a small simple dorsal tubercle. The opposing spine is sharp and rather large, reaching a height equal to half the width of the penultimate segment. The terminal claw is about as long as the penultimate segment and is curved and rather stout. The cirri as a whole are rather stout.

The radials are almost entirely concealed in the midradial line, but extend upward in the interradial angles of the calyx. The IBr$_1$ are about four times as broad as long, in contact basally or free, and bear a small mediodorsal tubercle. The IBr$_2$ (axillaries) are one-third again as broad as long, almost hexagonal, with a low longitudinal synarthrial crest rather slightly bordered in the proximal two-thirds.

The 10 arms are from 30 to 35 mm. long. They are smooth with rather long proximal brachials. The first brachials are interiorly united for two-thirds of their length. The second brachials are twice as long exteriorly as interiorly. The first and second brachials have a slight synarthrial prominence similar to that on the IBr series.

Syzygies occur between brachials 3+4 and 9+10 and distally at intervals of 3 muscular articulations.

P$_1$ and P$_a$ are absent. P$_2$ is 6.5 mm. long with 12 segments of which the first is short, the second is a little longer than broad, the third is twice as long as broad, and the fourth and fifth are from 3 to 4 times as long as broad, slender, with the ends somewhat expanded. From the third segment onward the distal ends are indistinctly collar-shaped and have spiny borders. P$_b$ is 6 mm. long. P$_3$ is 5 mm. long with 11 segments. P$_4$ is 3.2 mm. long with considerably shorter segments and a gonad. The distal pinnules are 5.5 mm. long with 16 segments of which the first and second, and the terminal, segments are short and the others are twice as long as broad.

The disk measures 4 mm. in its greatest and 2.5 mm. in its least diameter. It is incised, and is without calcareous granules. The anal tube is long, about 2 mm. high.

The arms are red-violet and the cirri are white.

Notes.—In a second specimen from station 43, as described by Gislén, the cirri are XXVIII, 16–19, from 3.5 to 5.5 mm. long. The 10 arms are 25 mm. long. P$_2$ is 5.5 mm. long with 12 segments. P$_3$ is 4.7 mm. long with 10 segments. P$_4$ is 3 mm. long with 10 segments. The distal pinnules are 5 mm. long with 15–17 segments. The disk is of the same size as in the specimen preceding. The anal cone is 1.5 mm. high. The color is a little lighter than in the preceding specimen, red gray with a light dorsal longitudinal band.

In the third specimen from station 43 the cirri have 14 or 15 segments. The radials are visible as narrow bands. The IBr$_1$ are laterally free. The synarthrial tubercles are indistinct. The 10 arms are 20 mm. long. P$_2$ is 4 mm. long with 9 segments. P$_b$ is 3 mm. long with 9 segments. P$_3$ is 3.5 mm. long with 8 segments. P$_4$ is 2.3 mm. long with 7 segments. The distal pinnules are 4 mm. long with 12 segments.

In the fourth specimen from station 43 the cirri are XV, 13, from 3 to 3.5 mm. long. The radials are easily visible, 6 times as broad as long. There are no synarthrial tubercles. The arms are broken off.

In a fifth specimen from station 43 the cirri are XVII, 13. The radials are as in the specimen preceding. The 10 arms are 12 mm. long. P$_2$ is 2.7 mm. long with 8 or 9 segments. P$_b$ is 2.7 mm. long with 7 segments. P$_3$ is 2.5 mm. long with 7 or 8 segments. P$_4$ is 1.5 mm. long with 8 segments. The distal pinnules are 2.5 mm. long with 10 segments.

In a sixth specimen from station 43 the cirri are XXVIII, 13–16, from 3.5 to 6 mm. long. The 10 arms are 27 mm. long. P$_2$ is 4.2 mm. long with 9 segments.

P_b is 4.2 mm. long with 9 segments. P_3 is 3.2 mm. long with 7 or 8 segments. P_4 is 2.5 mm. long with 8 segments. The distal pinnules are 5 mm. long with 16 segments.

In a seventh specimen from station 43 the cirri are XXIII, 14–16, from 2.5 to 3.5 mm. long. P_2 is 3.3 mm. long with 8 segments. P_b is 3.3 mm. long with 8 segments. P_3 is 3 mm. long with 8 segments. The disk is 3.5 mm. in the longest and 2 mm. in the shortest diameter.

In a specimen from station 53 the cirri are XXV, 15, from 4 to 5 mm. long. The opposing spine equals in height two-thirds the width of the penultimate segment. The 10 arms are 27 mm. long. P_2 is 3.5 mm. long with 8 segments. P_b is 3.5 mm. long with 8 segments. P_3 is 3 mm. long with 8 segments. P_4 is 2.7 mm. long with 8 segments. The distal pinnules are 4 mm. long with 15 segments. The disk is 3 mm. in diameter and is not distinctly incised. The anal cone is 2 mm. high.

In another specimen from station 53 the cirri are XIV, 12–15, from 3 to 4.5 mm. long. The 10 arms are from 15 to 20 mm. long. P_2 is 3 mm. long with 9 segments. P_3 is 2.5 mm. long with 9 segments. The distal pinnules are 4 mm. long with about 15 segments. The disk is 2.5 mm. in diameter.

A specimen from *Willebrord Snellius* station 60* does not seem to differ in any essential particular from those from the Bonin Islands described by Gislén. It was compared directly with one of these specimens, which the Museum owes to the kindness of Dr. Gislén, and the only differences found, the slightly fewer cirrus segments, and the greater length and slenderness of the fewer segments of the lower pinnules, are undoubtedly due to its smaller size. It may be described as follows:

The centrodorsal is discoidal, with the flat dorsal pole completely covered with numerous closely crowded rounded or more or less conical tubercles. The cirrus sockets are arranged in two closely crowded alternating rows. The cirri are XXII, 13–16 (usually 15), 4.5 mm. long. The first segment is very short, the second is about one-third again as broad as long, the fourth and fifth are slightly longer than broad, and those following slowly decrease in length so that the last four or five are slightly broader than long. The second and following segments have the distal dorsal edge raised and finely serrate, this almost immediately becoming a transverse ridge with a more or less strongly convex crest, rarely with prominent lateral angles; this transverse ridge gradually narrows distally so that the last two segments before the penultimate have a sharp median carination. The opposing spine is equal in length to about two-thirds the width of the penultimate segment, and is long, sharply pointed, slender, with the apex terminal or subterminal. The terminal claw is slightly longer than the penultimate segment and is moderately and evenly curved, slightly more so proximally than distally.

The radials are short, 5–6 times as broad as the median length, with the distal border approximately straight in the central two-fourths and curving broadly upward and outward in the lateral fourths. Their anterolateral angles are separated by a deep and rather broad U-shaped gap. The IBr_1 are about 5 times as broad as long in the median line and about twice as long laterally as in the median line, the distal border being deeply incised by a posterior projection from the axillary. The IBr_2 (axillary) is shield-shaped, slightly broader than long, with the two distal edges rather strongly concave, a sharp and somewhat produced distal angle, and the posterior border deeply bowed proximally in the form of a broadly rounded angle deeply incising the IBr_1.

The 10 arms are 20 mm. long. The first brachials are about 5 times as broad as long in the median line; their distal edge is parallel to the proximal from the inner side as far as the midradial line, then turns and runs diagonally upward and outward so that the outer side is twice as long as the inner, or even longer. The first brachials are separated interiorly for about half their length, or rather less, by a V-shaped gap of moderate width. The second brachials are larger than the first and are irregularly quadrate. The first syzygial pair (composed of brachials 3+4) is slightly longer interiorly than exteriorly, as long as, or slightly longer than, broad exteriorly, with the hypozygal somewhat larger than the oblong epizygal. The next two brachials are roughly oblong, broader than long, and those following are very obliquely wedge-shaped, longer than broad, becoming elongated and centrally constricted in the outer portions of the arms. The division series and brachials are densely clothed with an exceedingly fine spinulation. Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of 3 muscular articulations.

P_1 and P_a are absent. P_2 (on the fifth brachial) is 2.3 mm. long, stiffened, with 8 segments of which the first is slightly broader than long, the second is between half again and twice as long as broad, the third is four times as long as broad, and the remainder are greatly elongated, except for the terminal, which is about half the length of that preceding and ends in a few long spines. The long segments have slightly concave sides, and the distal ends on the side toward the arm tip are armed with several rather long spines. P_3 is similar, with 8 segments, and P_b and P_c are also similar. The pinnules following are shorter and flexible, and carry gonads.

The color in alcohol is yellowish white blotched with light brown laterally, and more intensively dorsally, but always with a broad median white stripe. The gonads and the adjacent pinnule segments are deep violet. The cirrus segments each have a broad light brownish saddle.

Remarks.—Dr. Gislén wrote that in a letter to him I had suggested that this species might possibly be identical with, or nearly related to, the "*Antedon impinnata*" mentioned by Dr. P. H. Carpenter from Mauritius. He said it is possible, though not very likely, that this species might be nearly related to Carpenter's species—from his very incomplete description one only learns that P_a, P_b, and P_2 are absent—but that it is identical with his species he considers to be out of the question, partly because of the statements about the number of cirri and cirrus segments, and partly on account of the geographical distribution. Besides, the statements about the pinnulation point rather to a young animal than to a fully grown individual. For in connection with the notice of the absence of P_2, P_a, and P_b nothing is said about P_1, and one must therefore suppose that this pinnule is present.

Localities.—Dr. Sixten Bock's Expedition to Japan, 1914; station 43; Bonin Islands; northwest of Ototojima; 146 meters; July 31, 1914 [Gislén, 1922] (1, U.S.N.M., E. 1110).

Dr. Sixten Bock's Expedition to Japan, 1914; station 53; Bonin Islands; Higashijima 2 miles east; 164 meters; sand and broken shells; August 7, 1914 [Gislén, 1922].

Willebrord Snellius station 60*; west of Zamboanga, Mindanao (lat. 6°58′00″

N., long. 121°52′30″ E.); 72–80 meters; September 5, 1929 [A. H. Clark, 1936] (1, L.M.).

Geographical range.—From southwestern Mindanao to the Bonin Islands.

Bathymetrical range.—From 72 to 80 meters; Dr. Bock's records represent the length of line out, not the actual depth.

History.—This species was described in 1922 by Prof. Torsten Gislén from 17 specimens collected by Dr. Sixten Bock, 15 at station 43 and 2 at station 53. In 1936 I recorded and gave notes on a specimen that had been dredged by the Dutch steamer *Willebrord Snellius* off southwestern Mindanao, Philippines.

Genus EMBRYOMETRA Gislén

Embryometra Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 4 (in combination as *Embryometra mortenseni*, new genus and species), pp. 5, 12.—Gislén, Lunds Univ. Årsskr., new ser., Avd. 2, vol. 34, No. 17; Fysiogr. Sällsk. Handl., new ser., vol. 49, No. 17, 1939, p. 12.

Diagnosis.—A genus of Colobometridae including small species with 10 arms 35–65 mm. long in which the cirri, which are fairly long and not especially slender, are composed of 14–19 segments having the distal dorsal edge thickened and obscurely spinous; P_2 is markedly longer than P_1 or P_3; P_a and usually also other of the proximal pinnules are absent; and the genital pinnules have the third-fifth segments broadened to protect the gonads.

Geographical range.—Known only from southwest of the Cape of Good Hope.

Bathymetrical range.—From 293 to 325 meters.

Remarks.—The genus *Embryometra* appears to be most closely related to the genus *Clarkometra*, though differing from it in several important features. The expansion of the third-fifth segments of the genital pinnules suggests a relationship to the southeast Australian *Austrometra* and the Caribbean *Analcidometra*.

EMBRYOMETRA MORTENSENI Gislén

Embryometra mortenseni Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 12, pl. 2, fig. 6, text figs. 12–15, p. 13 (localities; description; notes).

Description.—The centrodorsal is hemispherical, 1.7 mm. in diameter at the base, with a flattened dorsal pole about 0.7 mm. in diameter. The cirri are arranged in a partially double row.

The cirri are XVI, 16–18, about 6 mm. long, strongly recurved. The first segment is short, the second is from one-third again to twice as broad as long, the third is up to one-third again as long as broad, the fourth is one-third again as long as broad with the distal portion somewhat flaring, and those following are similar or a little shorter, the distal flaring gradually becoming more and more obsolete. The antepenultimate segment is one-quarter again as long as broad. The opposing spine is subterminal and erect. The terminal claw is curved, and is insignificantly longer than the penultimate segment. There are no dorsal spines. Professor Gislén said that when the cirri are viewed from the side there is a suggestion of an indistinct carination, but when viewed dorsally no such carination can be detected, though there seems to be a distal thickening with a very fine and obsolete spinosity—just as on the ends of comatulid brachials under high magnification.

The radials are very short in the median line but the anterolateral angles are produced interradially forming, together with those of their neighbors, an acute angle. The IBr_1 are almost quadrangular with obtuse anterolateral angles. There is a very moderate synarthrial tubercle. The IBr_2 (axillaries) are pentagonal, as long as broad, with the lateral borders converging somewhat proximally. The distal edges are slightly everted and concave so that the anterior angle is acute.

The 10 arms are about 65 mm. long. The first brachials are twice as broad as long, a little longer exteriorly than interiorly, interiorly in contact in the proximal three-fourths. The second brachials are one-third again as broad as long, with the first forming a small synarthrial tubercle. All the proximal brachials are slightly constricted centrally, giving this part of the arm a knobby appearance. In the middle and distal portions of the arms this feature becomes less and less pronounced. These brachials are from half again to twice as long as broad. Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of 2 muscular articulations.

P_1 is 3.5 mm. long with 10 segments. P_2 is about 5 mm. long with 12 segments. P_3 is 3.5 mm. long with 10 segments. P_4 is usually absent. P_5 and the following pinnules are present. P_a is absent in 8 cases, though P_b and in most instances also P_c are present. P_d is often absent, but the following inner pinnules are present. The segments of the proximal pinnules are smooth; the first is short, the second is half again as long as broad, the third is twice as long as broad, the fourth is two and one half times as long as broad, and the fifth and following are from 3 to 4 times as long as broad and are very indistinctly thickened distally. The distal pinnules are about 11 mm. long with about 25 segments of which the third-fifth, roofing the gonads, are a little flattened and broadened, and the distal are about 4 times as long as broad. The gonads are small, visible on the distal pinnules.

The disk extends to the sixth brachial.

The color in alcohol is light brownish.

Notes.—The preceding description was drawn up by Professor Gislén from the type specimen from Dr. Mortensen's station 56.

A specimen from Mortensen's station 57 has the cirrus-free dorsal pole of the centrodorsal a little convex, 0.7 mm. in diameter. The cirri, which are arranged in a double crowded row, are XXII, 18–19, about 7 mm. long, strongly curved, with the longest about one-third again as long as broad. They are attached to part of a sponge. The radials are distinctly visible, about four times as broad as long, laterally united except in the distal fourth. The IBr_1 are well separated from each other. The IBr_2 (axillaries) are almost hexagonal, and form an obsolete synarthrial tubercle with the IBr_1. The 10 arms are about 65 mm. long. On one postradial series one arm has syzygies between brachials 3+4, 9+10, 14+15, 17+18, and 20+21, and P_4, P_5, P_a, P_d, and P_a are missing; the other arm has syzygies between brachials 3+4, 9+10, 14+15, 17+18, and 20+21, and P_4, P_a, P_c, and P_d are missing. P_1, P_2, and P_3 are present; P_4 is almost always absent; P_a is absent on eight of the ten arms. P_7 and P_t bear the first gonads. P_1 is 3 mm. long with 9 segments, and is smooth and incurved over the high disk; the first segment is up to one third again as long as broad, the second is half again as long as broad, the third is two and one-half times as long as broad, the fourth is three times as long as broad, and the fifth is three and one-half times as long as broad; the distal segments are a little longer still and taper distally. P_2 is 4 mm. (probably originally 4.5 mm.) long with about 10 segments, stouter and stiffer than P_1, the tips arching over the surface of the disk; the third segment is three times as long as broad, and the longest segments are four times as long as broad. P_3 is 2.5 mm. long with about 8 segments. P_6 is 3.5 mm. long with 11 segments. P_7 is 4.5 mm. long with 11 segments. From this pinnule onward there are well-developed gonads on the third-fifth segments. The distal pinnules are 6 mm. long with 17 segments of which the first is twice as broad as long, the second is half again as long as broad, the third is three times as long as broad, and the longest are from four to five times as long as broad. The disk extends to the sixth brachial. The anal tube, which is distinctly visible between the arms, is long and naked. The color in alcohol is whitish, the perisome and the soft parts of the pinnules brown, and the pinnules light brown.

In another specimen from Mortensen's station 57 the cirri are XVI, 17, 6.5 mm. long, and are clinging to a hydroid. The arms are about 50 mm. long. P_a is absent on all the arms; P_4, P_d, and sometimes P_5 are absent.

In a third specimen from Mortensen's station 57 the centrodorsal is a flattened hemisphere with some interradial pits. The cirri are XII, 14–18, up to 6.5 mm. long. No basals are visible. The arms are 35+ mm. in length. The pinnulation is as before, but sometimes P_3 and P_c are also absent. The disk has been lost.

Professor Gislén said that with its long brachials and rather moniliform arm bases, and with the few-jointed cirri lacking dorsal spines or carination, this species has a very close resemblance to the Antedoninae. As P_a is absent, one might think of the Perometrinae, but the forms included in that subfamily are characterized by much longer cirri with more segments which, besides, are provided with spines. The other subfamily of Antedonidae to be considered in this connection is the Antedoninae. Within this subfamily *Andrometra* is the only genus that approaches the new form in the proportions between the proximal pinnules. But in *Andrometra* the the centrodorsal is conical and the characters of the proximal arm parts are very different. Besides, the defective pinnulation would be something unique within the Antedoninae. He concluded that in spite of a very antedonid appearance this new form is probably most correctly to be ranged within the Colobometridae.

He noted that the cirri, while in appearance the segments because of the distal flaring suggest the Antedoninae, resemble the cirri in some species of *Decametra.* Moreover, only very rarely in the Antedoninae is P_2 the longest pinnule, while in the Colobometridae this is a very usual feature. The curious pinnulation, he said, may be partly an adolescent phenomenon, since in the largest specimen the distal pinnule gap is filled up on some arms. But if this is the case it is quite unique, for it would be expected that the pinnule gaps would be filled before the gonads become swollen. He remarked that even if full grown individuals should prove to have complete pinnulation the new genus is easily distinguished from all other comatulid genera known by the following features: Hemispherical centrodorsal, few and short cirrus segments without spines but with indistinct distal collars, long jointed and knobby arms, and very long but smooth pinnulars, P_2 being the longest pinnule, and P_a being absent.

Professor Gislén wrote that when in 1922 he described the new genus *Clarkometra* he placed it in the subfamily Perometrinae of the Antedonidae, but that in 1936 I—as it seems to him quite correctly—transferred it to the Colobometridae. He remarked that *Embryometra* is still another very difficult intermediate link between the Colobometridae and some types of the Antedonidae. He said that on the basis of the diagnosis *Embryometra* falls outside the Colobometridae, but a careful investigation of its characters seems to place it as a near relative of that family.

He recalled that in 1924 he pointed out that the Macrophreata must be considered as a group of polyphyletic origin, and that there are probably series within the Antedonidae which have their ancestors near the Colobometridae. The evolution within the comatulids proceeds toward an ideal type, more or less antedonid in appearance, and therefore a decision regarding the systematic position may in some cases be rendered extremely difficult. The new form *Embryometra* seemed to him one more proof for his opinion.

The young of nearly all comatulids, and the very small species, converge toward a generalized type in which the characteristic features of the group to which they may belong tend to become more or less obscured, and the fully grown individuals in most of the subfamilies of the Antedonidae diverge from this generalized type less than the other comatulids. But in my opinion this does not indicate that the characteristic features of the various groups are not fundamental. The short, stout, strongly recurved cirri of *Embryometra* closely resemble those of many small species in the Colobometridae and are not found in any species in any subfamily of the Antedonidae. The antedonid features found in *Embryometra* I believe to be purely a result of that generalization usually associated with small size, without further significance.

Localities.—Dr. Th. Mortensen's station 56; southwest of False Bay, Cape of Good Hope (lat. 34°17 S., long. 17°58′ E.); 293 meters; mud; December 17, 1929 [Gislén, 1938].

Dr. Th. Mortensen's station 57; southwest of False Bay, Cape of Good Hope (lat. 34°21′ S., long. 17°57′ E.); 325 meters; mud; December 19, 1929 [Gislén, 1938].

Geographical range.—Only known from southwest of the Cape of Good Hope, South Africa.

Bathymetrical range.—From 293 to 325 meters.

Remarks.—This species is known only from the four specimens dredged by Dr. Th. Mortensen in 1929 and described by Professor Gislén in 1938.

UNIDENTIFIABLE SPECIES

[ANTEDON IMPINNATA P. H. Carpenter]

Antedon impinnata von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 15, 16, 18, 50, 60 (*nomen nudum;* North Bay, Mauritius, 15 fms.; myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 54 (10-armed species), p. 206 (in key to anomalous 10-armed species), p. 366 (found above 20 fms.), p. 378 (Mauritius, 15 fms.).—Braun, Centrabl. Bakteriol. und Parasitenk., vol. 3, 1888, p. 210 (myzostomes).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 47 (synonymy; diagonsis; unidentifiable; locality); Crinoids of the Indian Ocean, 1912, p. 34, 284 (same).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 142 (possible, but not likely, that this is closely related to *C. elegans*).—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 102 (indeterminable).

Cyllometra impinnata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 357 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 6 (listed).

Characters.—Cirri VIII–X, 12. P_a, P_2, and P_b absent.

Remarks.—Carpenter said that this is a little species, which was obtained at Mauritius by Professor Möbius, who was kind enough to show it to him when he visited Kiel. The only characters he gave for it are those given above.

When the genus *Clarkometra* was described I believed that Carpenter's *Antedon impinnata* might be a representative of it, related to or possibly identical with the type species, *C. elegans*, and I so wrote to Dr. Gislén. But he pointed out that Carpenter said nothing about P_1 in *Antedon impinnata*, so that, therefore, this pinnule is presumably present. He believes that "*Antedon impinnata*" is simply a young individual of some larger species, and on the basis of the available facts I quite agree with this conclusion.

Locality.—North Bay, Mauritius; 27 meters; Prof. Karl Mobius [von Graff, 1884; P. H. Carpenter, 1888; A. H. Clark, 1907, 1909, 1911, 1912; Gislén, 1922].

History.—*Antedon impinnata* was first mentioned by Prof. Ludwig von Graff who in 1884 described the myzostomes found upon the only known specimen. The myzostomes and the name of the host had been sent him by Dr. P. H. Carpenter.

In the *Challenger* report upon the comatulids published in 1888 Carpenter included *Antedon impinnata* in a key to five 10-armed species that did not seem to fit into any of the specific groups established by him.

In my first revision of the old genus *Antedon* published in 1907, I placed *impinnata* in the new genus *Cyllometra*, and it was listed as a species of *Cyllometra* in my revision of the family Himerometridae published in 1909. In my memoir on the crinoids of the coasts of Africa published in 1911, I listed *Antedon impinnata* as an unidentifiable species and gave the characters mentioned by Carpenter. It was similarly included in the list of unidentifiable species under the name *Antedon impinnata* in my memoir on the crinoids of the Indian Ocean published in 1912.

In 1922 Dr. Torsten Gislén pointed out that *Antedon impinnata* is probably merely a young individual of some other species.

Superfamily TROPIOMETRIDA A. H. Clark

Thalassometroida A. H. Clark, Amer. Nat., vol. 42, No. 503, 1908, pp. 722, 723 (includes *Thalassometra*, *Charitometra*, *Tropiometra*, and other genera).

Thalassometrida Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 231, 236, 237, 238, 239, 240; Ark. Zool., vol. 19, No. 32, 1928, p. 6.—Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, p. 151.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., No. 11, 1934, p. 7.

Tropiometrida A. H. Clark, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 560; Treubia, vol. 14, livr. 2, 1933, p. 213; John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 90.—H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 42.

Diagnosis.—A superfamily of the suborder Oligophreata in which all the pinnules are prismatic, triangular in cross section, with a sharp, or sharply rounded, dorsal keel; well-developed side- and covering-plates are usually, though not always, present along the pinnule ambulacra; the arms terminate abruptly, the minute terminal brachials being curved inward between the fully developed terminal pinnules, which extend for some distance beyond them; all the pinnules are present in all the species.

Geographical range.—From Japan, the western Aleutian, Hawaiian, and Galápagos Islands southward to the Kermadec Islands and Tasmania, and westward to east and south Africa from the Red Sea to the Cape and the Crozet Islands; in the Atlantic from Tristan da Cunha, Ascension, and southern Brazil northward to the Bay of Biscay and the Caribbean Sea.

Bathymetrical range.—From the shore line down to 2,926 meters. This superfamily is most abundantly represented between 100 and 900 meters, but many species range down to 1,400 meters; one family (Tropiometridae) is almost exclusively littoral, and there are sublittoral or even littoral species in the other families.

Remarks.—The superfamily Tropiometrida includes the families Tropiometridae, Calometridae, Ptilometridae, Asterometridae, Thalassometridae, and Charitometridae. The families Charitometridae, Thalassometridae, and Asterometridae are closely allied, having most of their characters in common; the family Ptilometridae, the species of which have a close superficial resemblance to those of the family Asterometridae, differs markedly in the structure of the radial pentagon; the family Calometridae is highly distinctive and cannot be confused with any other group; the family Tropiometridae is equally distinctive, although superficially the included species resemble certain species of Charitometridae.

Comparisons.—The species of Tropiometridae are all large or very large. The pinnules, though prismatic, are more or less flexible, at least distally, and the side- and covering-plates are minute and rudimentary, represented merely by spicules, or wholly absent. The centrodorsal is large with the cirri arranged in more or less regular alternating rows. The cirri are stout and rather short, without dorsal spines, and rather strongly recurved; they resemble the cirri in some of the species of Charitometridae. Very distinctive are the articular faces of the radials on which the muscular fossae are large and well rounded, about twice as high as the interarticular ligament fossae, with their lower inner corners occupied by supplementary muscle plates (see Part 2, pp. 38–40).

The family Calometridae is rather sharply set apart from the other families of the Tropiometrida. The species are all of medium size. P_1 is small, weak, and flexible, with the first two segments greatly enlarged and the remainder about as long as broad. One or more of the pinnules following are elongated and spinelike. The remaining pinnules are sharply prismatic, stiff, with very highly developed side- and covering-plates. The division series and arm bases are less closely appressed than they are in the species of the other families, and are sometimes (*Neometra*) widely separated. The centrodorsal is moderate, usually thick discoidal, with the cirri arranged in a few more or less irregular rows. The cirri are of moderate length and stoutness, with dorsal spines on the outer segments. The articular faces of the radials are highly distinctive. They are approximately crescentic and are entirely separated from each other. The interarticular ligament fossae have the distal border strongly concave, and the muscular fossae are very short, about as long as the dorsoventral diameter of the central canal, forming a bandlike border along the distal edge of the interarticular ligament fossae (see Part 2, pp. 40–41).

The species of Ptilometridae are of moderate size or rather large. The pinnules are prismatic and stiffened with the side- and covering-plates well developed. P_1 is smaller and more slender than the pinnules following, though otherwise similar to them. The centrodorsal is large with the cirri arranged more or less regularly in 15, or sometimes 20, closely crowded columns. The cirri are very long with very numerous segments of which the outer bear dorsal spines. As in the Tropiometridae and Calometridae, the articular faces of the radials are very distinctive; the interarticular ligament fossae are low triangles and the muscular fossae are reduced to narrow bands along their distal edge (see Part 2, pp. 42–44).

In general the species of the family Asterometridae resemble those of the family Ptilometridae, but the centrodorsal is small and more or less conical with the cirri arranged in 10 definite and usually well-separated columns; the cirri are larger and stouter and less numerous; and the division series and arm bases are narrower and more compressed with the component ossicles deeper and more broadly flattened laterally. The articular faces of the radials are essentially similar to those of the family Thalassometridae (see Part 2, pp. 44–45, *Asterometra macropoda*).

The numerous species of the family Thalassometridae vary from small to very large. The pinnules are prismatic and stiff, the distal sometimes becoming more or less flexible, with well developed side- and covering-plates. P_1 is longer and stouter, often much longer and much stouter, than the pinnules immediately following, which are always short. The centrodorsal varies from small and conical to large and thick discoidal, with the cirri usually in 10 or 15 regular columns, sometimes in more or less irregular rows. The cirri are usually long and rather slender with a well-developed transition segment beyond which the segments almost invariably bear prominent dorsal spines. The articular faces of the radials are essentially similar to those of the family Asterometridae; they differ from those of the family Charitometridae in having the very long muscular fossae parallel, making an obtuse angle with the interarticular ligament fossae (see Part 2, pp. 45–48).

The species of the family Charitometridae resemble in the main those of the Thalassometridae, but P_1 and P_2, rarely only P_1, are slender and are composed of numerous short segments, and the cirri are short, stout, strongly recurved, and composed of few segments none of which bear dorsal spines. The articular faces of the radials resemble in general those of the Thalassometridae, but the muscular fossae lie approximately in the same plane as the interarticular ligament fossae, and therefore distally (see Part 2, pp. 48–49).

The superfamily Tropiometrida, like the superfamily Mariametrida, is most strongly represented in the area from southern Japan to Australia. The family Asterometridae ranges from southern Japan and the Bonin Islands southward to the Kei and Lesser Sunda Islands and the western coast of the Malay Peninsula in from 5 to 256 meters, and the Calometridae ranges from southern Japan to tropical Western Australia and westward to the Andaman Islands in from 5 to 600 meters. These two families, therefore, have approximately the same range as the families Zygometridae and Eudiocrinidae in the superfamily Mariametrida, though they descend to considerably greater depths. The family Ptilometridae is confined to southern Australia, the species living from the shore line to a depth of 113 meters. In the superfamily Mariametrida a single species (*Austrometra thetidis*) of Colobometridae occurs in the northeastern portion of its territory. The family Tropiometridae ranges from southern Japan to northern Australia and westward to east and South Africa, St. Helena, and the western Atlantic from southern Brazil to St. Lucia, Trinidad, and

Venezuela; it is predominantly littoral and sublittoral, though the most wide-ranging species is reported from a depth of 508 meters. The family Thalassometridae is almost cosmopolitan in deep water, though it is not represented, so far as is known, in the very cold waters of the polar seas, on the west coast of America, or on the west coast of Africa south of the Gulf of Guinea; most of the species live in water of considerable depth, one descending to 2,926 meters, but a few are found in shallow water. The family Charitometridae is represented from southern Japan to the Kermadec Islands and the Sahul Bank and westward to east and south Africa, St. Helena, and the Caribbean Sea; most of the species live in water of considerable depth, and one is known from as great a depth as 2,194 meters. In the superfamily Tropiometrida three of the six families (Tropiometridae, Thalassometridae, and Charitometridae) are represented in east and south Africa and in the Caribbean Sea; in the superfamily Mariametrida one of the five families (Colobometridae) is represented by two species in the Caribbean Sea, and three (Himerometridae, Mariametridae, and Colobometridae) are represented on the east coast of Africa.

In the arrangement of the recent comatulids given in Part 3, page 65, the superfamily Tropiometrida included the families Tropiometridae, Calometridae, Thalassometridae (with the subfamilies Ptilometrinae and Thalassometrinae), and Charitometridae. The studies of my friend Prof. Torsten Gislén have indicated the advisability of raising the Ptilometrinae and Thalassometrinae to family rank, and also recognizing the family Asterometridae (previously included in the subfamily Ptilometrinae) with the genera *Asterometra* and *Pterometra*.

The interrelationships of the families included in the superfamily Tropiometrida as at present understood are made clear in the following key:

KEY TO THE FAMILIES IN THE SUPERFAMILY TROPIOMETRIDA

a^1. Ventral perisome of the pinnules not protected by conspicuous side- and covering-plates; cirri stout, without dorsal processes ---------- **Tropiometridae (p. 259)**

a^2. Ventral perisome of the pinnules protected by well developed and conspicuous side- and covering-plates easily visible with a hand lens.

  b^1. P_1 very delicate, weak, and flexible, with the first two segments enormously enlarged, those following small and about as long as broad; P_2 and usually also one or more of the following pinnules much elongated, enlarged, and stiffened, composed of much elongated segments; disk globose, compact, entirely enclosed in a pavement of plates and readily detached. **Calometridae (p. 346)**

  b^2. P_1 not delicate or weak, its first two segments not noticeably enlarged; P_2 like the following pinnules, more rarely like P_1, never especially distinguished; disk sunken within the division series or arm bases with the ventral surface concave, flat, or slightly convex, more or less thickly studded with isolated plates.

    c^1. Cirri usually long and slender, rarely of moderate length and rather stout, composed of more than 25 segments of which the distal are usually much shorter than the proximal, broader than long, and bear prominent dorsal spines or carinate processes; a well-marked transition segment usually present, beyond which the segments have the surface light in color and highly polished.

      d^1. P_1 similar to P_2, but shorter and smaller; cirri exceedingly long, from nearly as long as to longer than the arms.

        e^1. Centrodorsal large and broad, discoidal or columnar, the numerous cirri closely crowded and irregularly distributed, though tending to arrange themselves in 15 columns; radial areas of the centrodorsal never differentiated ------- **Ptilometridae (p. 393)**

        e^2. Centrodorsal a short more or less pentagonal column with a conical apex, the comparatively few cirri arranged in 10 definite columns; radial areas of the centrodorsal separated from each other by more or less developed ridges-- **Asterometridae** (p. 415)

d^2. P_1 longer and stouter than P_2, from slightly to very much longer and stouter; cirri never longer than the arms-------------------------- **Thalassometridae** (see Part 4c)

c^2. Cirri usually short, stout, and strongly recurved, rarely more or less elongated, composed of usually fewer than 25 segments of which the distal are little, if any, shorter than the proximal and do not bear dorsal processes, though they may have a low blunt tubercle at the distal end; all the segments uniform in color and surface texture; P_1 more slender than the pinnules following and composed of shorter segments; P_2 usually more nearly like P_3 than like P_1------------------------------ **Charitometridae** (see Part 4c)

Family TROPIOMETRIDAE A. H. Clark

Milberti group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 194.

Tropiometridae A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (includes *Tropiometra, Asterometra, Calametra,* and *Ptilometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 210 (in key), p. 211 (includes *Tropiometra, Ptilometra, Asterometra,* and *Calametra;* range; not represented in the Hawaiian Islands), p. 212 (range of component genera); Amer. Nat., vol. 42, No. 503, 1908, p. 722 (ecology); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (genera characteristic of Indo-Pacific-Japanese region), p. 605 (ecology); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 361 (*Antedon* P. H. Carpenter, in part), p. 362 (perfected ambulacral plating only in this family and in the Thalassometridae), p. 365 (covering plates differ from those in *Comatilia* in being in 2 series instead of in one; side- and covering-plates extraordinarily developed in *Calametra,* more or less imperfect in *Asterometra* and *Ptilometra,* and quite undeveloped in *Tropiometra:* side- and covering-plates not found in young of *Ptilometra* [in reality *Aporometra*]), p. 495 (comparison of ambulacral plating with that of West Indian species of the *Fimbriata* group of *Actinometra* [*Nemaster*]; Proc. Biol. Soc. Washington, vol. 22, 1909, p. 174 (referred to the Comatulida Oligophreata); Vid. Medd. Naturh. Foren. København, 1909, p. 133 (side- and covering-plates), p. 152 (cirri compared with those of *Zygometra fluctuans* [= *comata*]); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (3 species in African waters), p. 7 (species on west coast), p. 8 (species on southeast coast), p. 9 (species on northeast coast), p. 649 (referred to the Oligophreata); Die Fauna südwest-Australiens, vol. 3, Lief. 13, 1911, p. 438 (1 genus and 2 species in Australia); Mem. Australian Mus., vol. 4, 1911, p. 720 (proportion of the species of this family in the Australian fauna), p. 727 (restricted to *Tropiometra* only), p. 729 (young differ widely from adults; in key), p. 731 (one genus in Australia).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 371.—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 6 (number of genera in the East Indies; number also represented in the Atlantic; number represented in the Atlantic by closely allied genera; number exclusively confined to the East Indies; number of East Indian species), p. 11 (represented in the Ceylon region by *Tropiometra*), p. 12 (represented in the Red Sea and southeast African regions by *Tropiometra*), p. 23 (distribution in detail; down to 50 fathoms), p. 42 (revised so as to include *Tropiometra* only), pp. 46, 49 (in keys), p. 58 (includes only the genus *Tropiometra*); Bull. Inst. Océanogr. Monaco, No. 294, 1914, pp. 7, 8 (relation to temperature); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographic and bathymetrical ranges); No. 20, p. 582 (relation to temperature of habitat); Internat. Rev. gesamt. Hydrogr. und Hydrobiol., 1914, p. 4 and following (*Tropiometra* only genus; occurs in both Atlantic and Pacific; range); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (species collected by the *Endeavour* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (phylogenetical and paleontological significance of bathymetrical range); Die Crinoiden der Antarktis, 1915, p. 163 (represented in South Africa by *T. carinata*); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed discussion of the significance of the bathymetrical range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of the distribution of Australian species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. vii (not found by the *Albatross* in the East Indies), p. 131; Univ. Iowa Stud. Nat. Hist., vol. 9, No. 5, 1921, p. 12 (represented in the West Indies); Smithsonian Misc. Coll., vol 72, 1921, No. 7, p. 3.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 9, 90.—A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39.—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 35, 42, 78, 84, 90, 99, 231, 235, 280, 287; Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 30; Ark. Zool., vol. 19, No. 32, 1928, p. 6.—Mortensen and Lieberkind, Die Tierwelt der Nord- und Ostsee, Lief. 12, 1928, pp. viii, 87 (occurrence of ambulacral groove).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 646; Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 560.—H. L. Clark, Scientific Survey of Porto Rico and the Virgin Islands, vol. 16, part 1, 1933, p. 11.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, pp. 90, 101, 103.—Mortensen, Kongel. Vid. Selsk. Skrifter, nat. math., ser. 9, vol. 7, No. 1, 1937, p. 63 (larvae compared with those of *Lamprometra klunzingeri*).—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, pp. 4, 16.—Vaney and John, Trans. Roy. Soc. Edinburgh, vol. 59, pt. 3, No. 24, 1939, p. 664 (St. Helena; notes).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 23 (in key), p. 53.

Thopimetridae A. H. Clark, Amer. Nat., vol. 42, No. 503, 1908, p. 725 (typographical error; color).

Tropiomètres A. H. Clark, Bull. Mus. Hist. Nat., Paris, No. 4, 1911, p. 255 (includes *Tropiometra* only).

Tripiometridae Alexander, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 108.

Diagnosis.—A family of the superfamily Tropiometrida in which the ventral perisome of the pinnules is not protected by conspicuous side- and covering-plates, and the cirri are stout, without dorsal processes. The included species have normally 10 arms only.

Range.—The geographical and bathymetrical ranges of this family are given under the single included genus *Tropiometra* (see page 261).

Genus TROPIOMETRA A. H. Clark

Alecto (part) Leach, Zool. Misc., vol. 2, 1815, p. 63, and following authors.

Comatula (part) Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 2, 1816, p. 535, and following authors.

Comatula (*Alecto*) (part) J. Müller, Abh. preuss. Akad. Wiss., 1847, 1849, p. 252.

Antedon (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29, and following authors.

Actinometra (part) Springer, Mem. Mus. Comp. Zool., vol. 25, No. 1, 1901, p. 51 (compared with *Uintacrinus*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 403 (Berl. Mus., MS.).

Tropiometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (diagnosis; genotype, *Comatula carinata* Lamarck, 1816); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 246 (same); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (referred to the Tropiometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Tropiometridae), p. 212 (occurs in the West Indies and Japan), p. 275 (enlargement of the elements of the IBr series and first 2 brachials); vol. 35, 1908, p. 120 (arm structure; enlargement of the first 2 brachials); Amer. Nat., vol. 42, No. 503, 1908, p. 723 (range; habitat); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (faunal characters); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (absence of side- and covering-plates); Vid. Medd. Naturh. Foren. København, 1909, p. 193 (probably occurs at Singapore, though not yet discovered there); Proc. U. S. Nat. Mus., vol. 38, 1910, p. 213 (larvae possibly plutei, because of the wide distribution of the species); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 255 (division series and arm bases compared with those of *Oligometra adeonae*); Mem. Australian Mus., vol. 4, 1911, p. 728 (family Tropiometridae restricted to cover this genus only), p. 731 (in key), p. 735 (key to the Australian species), p. 779 (original reference; characters; range); Crinoids of the Indian Ocean, 1912, p. 11 (large species absent from the west coast of the Malay Peninsula, from the Andamans, and from farther west; represented in the Ceylon region), p. 12 (represented in the Red Sea and southeast African regions), p. 23 (distribution in detail), p. 42 (only genus in Tropiometridae as revised), p. 58 (only genus in the family), p. 176 (original reference; type); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, p. 4 and following (range); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod.

II, Crinoidea, 1914, p. 309 (migrant into the Atlantic from the southwest Indian Ocean; connects the Caribbean Sea with the southwest Indian Ocean), p. 312 (with *Antedon* the only genus of crinoids known from west Africa; species in the genus, with the range of each [*afra, macrodiscus, picta, carinata, audouini, indica*, and *encrinus*]); Die Crinoïden der Antarktis, 1915, p. 164 (geographical range), p. 181 (both Atlantic and Pacific; range in each); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 131 (key to the included species).—H. L. CLARK, Carnegie Inst. Washington Publ. 281, 1919, p. 53.—MORTENSEN, Vid. Medd. Dansk Naturh. Foren., vol. 71, 1920, p. 150.—A. H. CLARK, Univ. Iowa Stud. Nat. Hist., vol. 9, No. 5, 1921, p. 13 (West Indies and Indo-Pacific), p. 17 (in key); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, p. 19 (littoral occurrence), p. 34 (odor).—GISLÉN, Nova Acta Reg .Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 90.—A. H. CLARK, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).—GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 36, 51, 59, footnote 1, 84, 280.—A. H. CLARK, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 564 (status of small Indo-Pacific species).—EKMAN, Zoogeographica, vol. 2, No. 3, 1934, pp. 328, 343 (zoogeographic significance); Tiergeographie des Meeres, 1935, p. 67.—MORTENSEN, Kongel. Vid. Selsk. Skrift., nat. math., ser. 9, vol. 7, No. 1, 1937, pp. 61–65 (larvae compared with those of *Lamprometra klunzingeri*).—GISLEN, Lunds Univ. Årsskr., new ser., Avd. 2, vol. 40, No. 8, 1944, p. 54, footnote 1.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 53.

Tripiometra PRESTON, Zool. Rec. for 1921, 1923, p. 20 Echin. (editorial error).

Tropimetra GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 91 (editorial error).

Diagnosis.—The diagnosis of the family Tropiometridae given on page 260 will suffice for the genus *Tropiometra.*

Geographical range.—From the Korean Straits to Sagami Bay, and the Bonin Islands, southward to Bowen, Queensland, and to between Fremantle and Geraldton, Western Australia, and westward to the east coast of Africa, from Suez to the Cape of Good Hope; St. Helena; from St. Lucia westward to Venezuela and southward to Santa Catarina Island, southern Brazil.

Bathymetrical range.—From the shore line down to 508 meters. For the small species (*carinata*) there is only one record for more than 55 meters—off St. Lucia in 508 meters. The large species (*afra*) descends to 110 meters, and possibly to 146 meters.

Occurrence.—The species of this genus are for the most part very irregularly distributed, being very local, though usually abundant wherever they are found.

Remarks.—The interrelationships of the smaller species of this genus have given rise to considerable discussion. Count Pourtalès in 1878 wrote that specimens from Mauritius, the type locality of *carinata*, differed only in some minor details from others from Brazil. In the year following Rathbun said that the study of a large series of specimens would probably serve to unite the Brazilian with the East African species beyond all doubt. Under the name of *braziliensis* he mentioned a specimen from Rio de Janeiro that represented a rather strongly marked variety; this he seems properly to have regarded as merely an individual variant. This specimen had been listed by Professor Verrill as *braziliensis* in 1867, and its extravagantly developed characters led him in 1868 to regard a more typical specimen from the Abrolhos Islands as Böhlsche's *dübenii.*

In 1879 and 1880 Carpenter regarded specimens labeled *braziliensis* as representing a valid form distinct from *carinata;* but in 1881 he said that although he had been at first inclined to follow Lütken in separating *braziliensis* from *carinata*, further study had led him to believe in their specific identity, in agreement with Pourtalès and

Rathbun. Professor Ludwig in 1882 considered the Brazilian form and that from Mauritius specifically identical. In the *Challenger* reports (1884 and 1888) Carpenter included under *carinata* all the forms now included in the genus *Tropiometra* that were known to him.

Professor de Loriol in 1893 after personal investigation reaffirmed the specific identity of specimens from Mauritius and Rio de Janeiro, but in 1897 Professor von Ihering recorded specimens from Brazil as *braziliensis*. There is no evidence, however, that he compared these specimens with others from elsewhere.

In 1907, upon the establishment of the new genus *Tropiometra*, I listed *Tropiometra braziliensis* in addition to *T. carinata;* but this meant nothing more than the listing under the new generic name all described forms assignable to it, whether valid or not. In 1908 I recorded 6-rayed specimens from Rio de Janeiro under the name *Tropiometra carinata*, and in 1909 I recorded as *T. carinata* specimens from Zanzibar and the "East Indies," mentioning under the same name others from the western Atlantic. In 1911, however, after having studied the material in the museums of Europe in 1910 and having examined the types of Gay's *picta* in Paris, I recognized *carinata* and *picta* (from St. Helena and the western Atlantic) as distinct, and briefly diagnosed a third species, *encrinus*. To these were added in 1912 *audouini* from the Red Sea and *indica* from Ceylon and the adjacent parts of India. These five forms have been maintained by me ever since.

Dr. Clemens Hartlaub in 1912 included all the smaller forms in the genus *Tropiometra* under *carinata*, following Carpenter (1888).

Dr. August Reichensperger said (1913) that it seemed very questionable to him whether *encrinus* could be maintained as distinct from *carinata*. He believed that at best it might be considered as a geographical variety. He remarked that I gave *carinata* from the south African region, and *encrinus* as ranging from Aden to the East Indies and farther eastward, being especially common at Ceylon. He noted that I had based *encrinus* almost exclusively on the form of the cirri and of the cirrus segments, but from my statement there is little of a definite nature to be gathered. He quoted the remarks made by me under *Tropiometra encrinus* in 1911 (see p. 288) and said that a further supplement to this not very detailed specific description was published in 1912. Here he quoted my notes on the 14 specimens of *indica* from Ceylon in the British Museum (p. 338). Reichensperger said that there remains as the single, in some measure valid, differential feature separating *carinata* from *encrinus*, the partial third row of cirri on the centrodorsal of the latter; but this feature is not always present, as of the 11 specimens he had before him from Ceylon 4 were without it. He said that there is just as little to be learned from the carination of the brachials or the relative stiffness of the lower pinnules. He noted that in his opinion the remark expressed by me before the separation of *encrinus* that "specimens from south Africa, east Africa, the East Indies, and the South Pacific ocean are very uniform in their characters and agree in having a moderate or slight carination of the brachials" is correct. Reichensperger said that I had pointed out that in specimens from Brazil and the West Indies the carination of the arms is as a rule more marked and that it sometimes may become especially strong; when this happens the ends of the pinnule and cirrus segments are spinous. He added that I continued, "on the other hand, specimens may readily be found quite as smooth as any from the Indian Ocean."

He gave a table showing the variations in 11 specimens from Ceylon (see p. 338). He pointed out that in these the number of the cirrus segments is most constant. These are always broader than long, as given by Carpenter for *carinata;* but the relation of the breadth to the length is not always the same, as is seen by a comparison between the length of the cirri and the number of the component segments. Carpenter gave XX–XXX cirri with 20–30 segments. He pointed out that Carpenter said that some relatively young individuals were taken at Bahia by the *Challenger*, and that "They differ from the mature individuals in the greater length of the arm- and cirrus-joints." In Reichensperger's opinion Carpenter was entirely correct in not separating the forms he included under *carinata*, for these appear to be inextricably united with each other. Transitional forms, which are much more common than the extreme or typical forms, prove that *Tropiometra carinata* is to be considered, as was done by Count Pourtalès and Carpenter, as a single specific stock whose enormous geographical range with diversified living conditions leads to the appearance of varieties or racial stocks which in no way lose the specific characteristics, and at the most vary one from another only in the slightest degree. Reichensperger concluded that an attempt to establish discontinuous specific divisions among the forms of *carinata* would lead not to clarifying, but to obscuring the mutual relationships within this interesting group.

In 1915 Dr. Hubert Lyman Clark recognized *encrinus* and *indica* as valid forms, recording both from Ceylon. In 1916 Dr. Clark compared in minute detail long series of specimens from Tobago, British West Indies, from Brazil, and from Mauritius and Zanzibar, coming to the conclusion that they all represent the same specific type. This conclusion was in the same year accepted by Mortensen, who had been with Dr. Clark at Tobago. Mortensen did not himself look into the matter, but simply, and quite properly, accepted his colleague's conclusions.

In 1932 I published a detailed description of *Tropiometra encrinus* based upon five specimens from near Mandapam in the Madras Presidency of India. I also was able to study other specimens from the eastern coast of India. The specimens from Mandapam were very large, some of them with the arms about 180 mm. in length. Furthermore, the brachial carination was much reduced, becoming obscure after the proximal fourth of the arms and completely disappearing in the outer half. At first glance these specimens look more like examples of *T. afra* or an allied form than like examples of a form allied to *carinata*. The other specimens from the eastern coast of India are in general agreement with these, though not so large. The brachial carination is much reduced, usually disappearing in the outer half of the arms, though very faint suggestions of it may remain.

In 1933 Dr. Torsten Gislén made a careful comparison between 18 specimens from St. Helena and others from Tobago, Portuguese East Africa, and Zanzibar. These were compared with specimens in the Copenhagen Museum identified as *Tropiometra encrinus* by the author. His conclusions were that *encrinus* seemed to be a valid form, but that *picta* from the western Atlantic must be regarded as a synonym of the African *carinata*.

On reëxamining the question of the interrelationships of these forms I find myself in agreement with my colleagues Drs. Clark and Gislén. There are no tangible differences between specimens from the southeastern African region (typical *carinata*) and Brazil (the so-called *picta*). In this connection I would call attention to a specimen from Mauritius in the Berlin Museum (No. 1083; see p. 298) in which the carination of the arms is very greatly developed, as in certain specimens from Rio de Janeiro, each carinate process bearing a tuft of fine spines. African specimens are rather more likely to be uniformly colored than are those from Brazil, which makes them appear to be different; but the presence or absence of yellow markings, though altering the appearance of the individuals, is of not the slightest systematic significance in this group. It is probably, at least for the most part, simply a response to local conditions of illumination.

The form which I have called *indica* is a well-marked local race of *carinata* confined so far as we know at present to western Ceylon and the adjacent portions of southern India and distinguishable by the small, short, and usually numerous cirri with relatively short segments. The brachial carination is less developed than in the majority of specimens of *carinata* and is never strongly developed.

The form from the eastern coast of India (? and eastern Ceylon) reaches a larger size than the others. In this form, *clarki*, the cirri are relatively larger with usually more numerous segments and the brachial carination is obsolescent and entirely, or almost entirely, absent in the distal half of the arms. This form is intermediate between typical *carinata* and the large smooth *afra* occurring from northern Australia to Japan.

The occurrence on the eastern coast of India of a form intermediate between *carinata* and *afra* renders it highly improbable that any representative of the *carinata* type occurs farther eastward than Java—if indeed it is really represented there.

In the light of this inference the specimens supposed to be from Polynesia were reëxamined. They were found to represent *carinata*, agreeing in all respects most minutely with others from Rio de Janeiro. They were undoubtedly collected by the United States Exploring Expedition during its stay at that port and subsequently mislabeled (see p. 319). Carpenter's record from Norfolk Island was probably based upon some misapprehension, as no specimen exists from that locality (see p. 287), and the record from the Bonin Islands seems to rest upon a young individual of *T. afra macrodiscus*.

The two large forms, *afra* and *macrodiscus*, undoubtedly represent the same specific type—*afra*. Whether *macrodiscus* should be differentiated as a recognizable subspecies or simply merged with *afra* is as yet a matter of personal opinion. Pending the study of additional specimens of typical *afra* I have preferred to let *macrodiscus* stand as a northern subspecies.

In 1910 I wrote that the larvae of *Echinus* are highly specialized pelagic plutei, those of *Antedon* almost annelidan in character and with a greatly reduced duration of free existence. This would seem to indicate a great phylogenetic difference. But the species of *Antedon* are of exceedingly limited range. Those of *Tropiometra* have a very wide range, necessitating a prolonged free-swimming stage. Are we not justified in saying that the larvae of *Tropiometra* may turn out to be plutei or something like them? Mortensen said that, though this suggestion stimulated his interest in investigating the early stages of *Tropiometra carinata*, the results of his study did not bear out my expectation. He wrote that he expected that some day a crinoid may be found with a truly pelagic larva resembling a pluteus or a bipinnaria, but he thought it more probable that we may find it in some stalked crinoid. He said that in the comatulids he would expect the case to be the same as in the dendrochirote holothurians, all having a simple larva provided with ciliated rings, but not otherwise specially adapted to a pelagic life. He remarked that the character of the egg bears a relation to this. In all the numerous dendrochirotes he has examined the eggs are large and yolk laden, and he had no doubt that the larvae in these, and probably all other dendrochirotes, will prove to be of the usual simple cucumarian type. In all the crinoids he examined the eggs are likewise rather large and rich in yolk, and he said that he must infer from this fact that their larval form will also be of the usual simple type. He recalled that I stated that in the Thalassometridae the eggs are small, and accordingly I presumed that they have a long free-swimming stage, adding that it would be of considerable interest to study the development of some species of this group, for if the eggs are really noticeably smaller in the Thalassometridae than they are in other crinoids, and especially if they are less supplied with yolk, we may expect their development to afford features of unusual interest. He said that he did not have a sufficient representation of the family Thalassometridae at his disposal for investigating the character of their eggs; only in *Parametra orion* he found the eggs to be a little smaller than those of *Tropiometra carinata*—0.15 mm. in diameter as compared with 0.2 mm. in the latter. Regarding *Tropiometra carinata* he found that the larvae are not plutei or anything like that. Still there is something in the development to account for the wide distribution of the species. First the egg is free, probably pelagic, and second the larvae, which are very active swimmers—in the jars they were generally found swimming at the surface—may keep up their pelagic existence for quite a long while. If they find a suitable place for fixation they may attach themselves when only two or three days old, otherwise they may swim for six or seven days, and he had one individual that did not attach itself until it was eight days old. He remarked that as a result of this facultative prolonged swimming period the larvae may be carried for considerable distances by currents, and this accounts in a natural way for the wide distribution of the species.

KEY TO THE SPECIES AND SUBSPECIES IN THE GENUS TROPIOMETRA

a^1. Arms evenly convex dorsally with no trace of a median carination or of median tubercles on the distal ends of the brachials; size large, the arms usually about 200 mm. long, sometimes much longer.

b^1. Slender, the arms narrow and strongly rounded dorsally, the brachials beyond the base of the arm triangular or wedge-shaped, from half again to twice as broad as the longer side (Gulf of Aden; 73–220 meters) ---------- **magnifica** (p. 266)

b^2. Stout, the arms broad and more gently rounded dorsally, the brachials beyond the base of the arm very short, discoidal or broadly oblong (from between Fremantle and Geraldton, Western Australia, and from Bowen, Queensland, northward to Mindoro, Philippine Islands; from Hong Kong northward to the Korean Straits and eastward to Sagami Bay and the Bonin Islands; 0–110 [?146] meters) ---------- **afra** (p. 268)

c^1. Cirri with 21–35 (averaging 29) segments, 25–40 (averaging 35) mm. long (Mindoro, Philippines, and southward to Bowen, Queensland, and to between Fremantle and Geraldton, Western Australia; 0–110 [?146] meters) ---------- **afra afra** (p. 268)

c^2. Cirri somewhat longer and stouter, with 27–43 (usually about 35) segments, 30–50 (usually about 40) mm. long; a more robust and rugged form than the preceding (from Hong Kong northward to the Korean Straits and eastward to Sagami Bay, Japan, and the Bonin Islands; 0–66 [?91] meters) ---------- **afra macrodiscus** (p. 272)

a^2. Arms, at least in the proximal half, with a median dorsal carination, each brachial with a median ridge or a terminal median tubercle extending more or less backward in the mid-dorsal line; size smaller, the arms not over 180 mm. long, and usually less than 130 mm. in length (Java and the western side of the Bay of Bengal and westward to east Africa from the Red Sea to the Cape of Good Hope; St. Helena; Venezuela to St. Lucia and southward to Santa Catarina Island, southern Brazil; 0–55 meters; 508 meters off St. Lucia)------------**carinata** (p. 291)

  b^1. Outer half of arms quite smooth dorsally, wholly without a trace of carination, or with the carination feebly indicated; cirri relatively large, 20–35 (averaging 24) mm. long, with 19–34 (averaging 25) segments; arms up to 180 mm. in length, though seldom exceeding 150 mm. (northeastern coast of Ceylon and northward along the eastern coast of India to Waltair; ?Java; 0–9 meters)--**carinata clarki** (p. 281)

  b^2. Arms carinate to the tip; cirri smaller.

    c^1. Cirri with more than 20 segments; proximal pinnules not spine-tipped.

      d^1. Cirri with 20–32 (usually 23–24) segments, 15–27 (usually 18–20) mm. long; arms up to 180 mm. long, but seldom more than 130 mm. (Cargados Carajos, the Seychelles, Farquhar Atoll, Mauritius, Madagascar, and Reunion, and the African coast from Zanzibar southward and westward to False Bay, Cape of Good Hope; St. Helena; from Santa Catarina Island, southern Brazil, northward to St. Lucia, Tobago, Trinidad, and Venezuela; 0–55 meters; 508 meters off St. Lucia)---------**carinata carinata** (p. 291)

      d^2. Cirri with 20–26 (usually 20–22) segments, 15–22 (averaging 18) mm. long (coast of Travancore State, southwestern India, the Gulf of Manaar, and the western and southwestern coasts of Ceylon; 0–15 [?73] meters)----------------**carinata indica** (p. 337)

    c^2. Cirri with 16–18 segments, 13 mm. long; proximal pinnules spine-tipped; arms 50–80 mm. long (Red Sea and eastward to Muscat; littoral)------------**carinata audouini** (p. 342)

TROPIOMETRA MAGNIFICA A. H. Clark

PLATE 33, FIGURES 170–173

Tropiometra magnifica A. H. CLARK, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936 p. 87 (listed), p. 90 (*Mabahiss* station 24); description, p. 91 (comparisons); pp. 101, 104, 105; pl. 1, fig. 1.

Diagnostic features.—A very large, but slender, form with the arms narrow and strongly rounded dorsally, the brachials beyond the base of the arms triangular or wedge-shaped, from half again to twice as broad as the length of the longer side. The cirri are XXV, 35–37, 60–65 mm. long. The arms are 265 mm. long.

Description.—The centrodorsal is thick discoidal, 9 mm. in diameter at the base with a broad convex dorsal pole 7 mm. in diameter. The cirrus sockets are arranged in two crowded, alternating, and more or less irregular marginal rows.

The cirri are XXV, 35–37, the longest, about the periphery of the centrodorsal, 60–65 mm. long. The first segment is very short, the second is about three times as broad as long, and those following gradually increase in length to the eighth, which is about as long as broad, and the eleventh, which is somewhat longer than broad. The segments following are similar, the distal becoming slightly shorter, so that the last 12 or 14 are about as long as broad, and the last two slightly broader than long. The segments in the outer half of the cirri are slightly compressed laterally and faintly carinate in the mid-dorsal line. The longer earlier segments may be slightly constricted centrally. The opposing spine is minute and terminal, or altogether absent. The terminal claw is somewhat longer than the penultimate segment, rather stout, and moderately curved.

The radials project slightly beyond the rim of the centrodorsal. Their distal edge is slightly and regularly concave, so that they are about twice as long in the interradial angles as in the midradial line. The IBr_1 are very short, 6–7 times as broad as long, with the proximal and distal edges nearly straight and parallel, and the lateral edges slightly divergent and slightly convex. The IBr_2 (axillaries) are triangular with slightly truncated lateral angles, and are twice as broad as long. The anterior angle is slightly greater than a right angle, and is slightly grooved at the apex. The lateral borders of the IBr series and first two brachials are straight and are almost or quite in contact with those of their neighbors.

The 10 arms are 265 mm. long. The first brachials are wedge-shaped, about twice as long exteriorly as interiorly, nearly four times as broad as the median length, with the proximal and distal edges straight and parallel, and the inner edges united basally, diverging at a right angle distally. The second brachials are similar to the first, but the proximal and distal ends are slightly more oblique. The first syzygial pair (composed of brachials 3+4) is oblong, nearly twice as broad as long. The brachials following are wedge-shaped with the longer side more than twice as long as the shorter, and about twice as broad as the greater length; after the sixteenth the brachials become triangular with the proximal and distal edges somewhat sinuous, half again as broad as long. After the proximal fourth of the arm the brachials slowly become shorter with the ends less oblique, in the middle of the arm being wedge-shaped and twice as broad as long. Distally the obliquity of the ends still further decreases, and terminally the brachials increase in length, becoming as long as broad.

Syzygies occur between brachials 3+4 and 9+10, from between brachials 11+12 to between brachials 15+16 (usually between brachials 14+15), and distally at intervals of from 6 to 9 (usually 7 or 8) muscular articulations. On one arm syzygies occur between brachials 3+4, 6+7, 10+11, and 15+16.

P_1 is 22 mm. long, slender and evenly tapering, composed of 28 segments of which the first is somewhat broader than long, the second is somewhat longer than broad, and those following slowly increase in length so that the distal are about twice as long as broad. From the fourth onward the segments have a sharp ridge on the outer side which is slightly convex in profile and finely and irregularly serrate. The area between this and the sharp ventral ridge is slightly concave. P_2 is 18 mm. long with 27 segments and resembles P_1. P_3 is 18 mm. long with 25 segments and resembles the pinnules preceding, as does P_4, which is 18 mm. long with 26 segments. P_5 is 19 mm. long with 28 segments and is very slightly stouter than the preceding pinnules. P_6 is 20 mm. long with 27 segments, and resembles P_5. The pinnules following are similar. P_{25} is 17 mm. long with 27 segments. The distal pinnules are exceedingly slender, 16 mm. long and with 30 segments which are very slightly constricted centrally and have slightly serrate distal ends.

The color in alcohol is white with a broad, irregular, and frequently interrupted dorsal band of purple on the division series and arms. The cirri are more or less shaded or spotted with purple, the segments often with purple saddles or spots, and the distal pinnules are more or less blotched with purple. The color in life was recorded as pale viridine yellow on the disk and arms, with the dorsal arm stripe taupe brown. This change in color after preservation in alcohol recalls a similar case in *Amphimetra tessellata discoidea*. A color sketch of a specimen of the latter from *Siboga* station 99 was made at the time of capture. This showed the animal as light yellow with the ventral perisome of the arms and pinnules, though not the disk, dark yellow-brown.

When the specimen reached me ten years later it was yellow-brown with the cirri and pinnules purple.

Locality.—*Mabahiss* station 24; Gulf of Aden (lat. 11°53′42″ N., long. 51°13′12″ E.); 73–220 meters; October 9, 1933 [A. H. Clark, 1936] (1, B. M.).

Remarks.—As yet this interesting species is known only from the single individual dredged by the *Mabahiss.*

TROPIOMETRA AFRA AFRA (Hartlaub)

Plate 31, Figures 166, 167; Plate 32, Figure 168; Plate 33, Figure 174

[See also vol. 1, pt. 1, fig. 88 (lateral view), p. 145; pt. 2, fig. 116 (division series), p. 79; fig. 167 (division series), p. 86.]

Antedon afra Hartlaub, Nachr. Ges. Göttingen, May 1890, p. 172 (description; Bowen, Queensland); Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 86 (Bowen; detailed descriptions and comparisons), pl. 5, figs. 50, 52.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 481 (related to *A. macrodiscus*); Vid. Medd. Naturh. Foren. København, 1909, p. 117 (= *Tropiometra afra*); Mem. Australian Mus., vol. 4, 1911, p. 718 (of Hartlaub, 1890, 1891 = *T. afra*); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 2 (same); Crinoids of the Indian Ocean, 1912, p. 37 (same).

Tropiometra afra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 315 ("South Pacific"; specimens from Sagami Bay are *macrodiscus*); Amer. Nat., vol. 42, No. 503, 1908, p. 725 (color); Geogr. Journ., vol. 32, No. 6, 1908, p. 607 (color); Vid. Medd. Naturh. Foren. København, 1909, p. 184 (synonymy; considered as including *macrodiscus;* Bowen, Queensland; "South Pacific," probably Australia; characters of the specimens; specimens from near the Goto Islands and from Misaki are *macrodiscus*); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 440 (East Indian species occurring south to Bowen), p. 443 (range on the east coast); Mem. Australian Mus., vol. 4, 1911, p. 718 (identity), p. 721 (occurs south to Bowen), p. 735 (in key), p. 780 (annotated synonymy; characters; Australian records; range); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 2 (identity), p. 28 (Bowen; Hartlaub's type; description; *macrodiscus* a good species); Crinoids of the Indian Ocean, 1912, p. 23 (range), p. 37 (identity), p. 176 (synonymy: considered as including *macrodiscus;* range); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (collected by the *Endeavour* in Western Australia), p. 115 (Australian tropical species; previously known only from Bowen), p. 125 (between Fremantle and Geraldton, 60–80 fms.; characters of the specimens; history; comparison with *macrodiscus*); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 312 (range).—Alexander, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 108 (between Fremantle and Geraldton).—A. H. Clark, Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of distribution in Australia).—H. L. Clark, Carnegie Inst. Washington Publ. 212, 1915, p. 106 (southwestern reef-flat, Maër), p. 111 and following (habits and reactions).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. ix (relationship with *T. macrodiscus*), p. 131 (in key; range), p. 132 (notes; Sta. 164), p. 273 (listed), pl. 28, fig. 106.—H. L. Clark, Echinoderm fauna of Torres Strait, 1921, p. 8 (secured by the Carnegie Exped.), p. 25 (Mer; color; habits).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 7, 9, 91, 92 (Africa, Australia, New Guinea).—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 91 (compared with *T. magnifica*, new species), p. 105.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 53 (localities; notes).

Antedon afer (Lütken, MS.) A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 117 (= *Tropiometra afra*).

Diagnostic features.—A large stout form with the dorsal surface of the arms smooth, without any trace of a median carination. The cirri are XXIII–L (averaging XXXI), 21–35 (average 29), 25–40 (averaging 35) mm. long. The arms are 190–220 (averaging 200) mm. long.

This form is less robust and rugged than the following (*macrodiscus*) with somewhat shorter and more slender cirri which are composed of fewer segments.

Description.—The centrodorsal is thick discoidal with the rather large bare polar area flat or slightly concave. The cirrus sockets are arranged in two, or two and a partial third, closely crowded irregular, or more or less regular, marginal rows.

The cirri are XXXI–L, 30–35 (usually 30), 30 mm. long. All the segments are subequal, about twice as broad as long, the basal somewhat shorter. The dorsal side of the segments is perfectly smooth. The penultimate segment is comparatively small, about as long as broad, with the dorsal surface convex. There may be a small and weak opposing spine. The terminal claw is short and blunt, conical, and only slightly curved.

The radials are entirely concealed by the centrodorsal, or are very slightly visible. The IBr_1 are short and broad, oblong, about five times as broad as long, sharply flattened and in close lateral apposition. The IBr_2 (axillaries) are triangular, about twice as broad as long, and are also in close lateral apposition. A slight synarthrial tubercle may or may not be present.

The 10 arms are 190–200 mm. long, massive basally but tapering rather rapidly and becoming comparatively slender after the basal third. They have a rough dorsal surface. The first brachials are wedge-shaped, rather large, inwardly united for most of their length, outwardly straight and in close apposition with those on the arms adjacent. The second brachials are similar, but larger. They are wedge-shaped with the shorter side inward, and are in contact with their neighbors outwardly, but not inwardly. The first syzygial pair (composed of brachials 3+4) is oblong, two and one-half times as broad as long. The brachials following are very short, especially after the thirteenth or fourteenth, and discoidal or broadly oblong. After the eleventh or twelfth the brachials develop forward-projecting laterodorsal obtuse angles on the distal edge on alternate sides of the median line which gradually become obsolete after the basal third of the arm. The first nine or ten brachials have smooth distal edges. Weak and low articular tubercles may be developed. There is a slight synarthrial tubercle on the articulation between the first two brachials. The brachials beyond the ninth or tenth have slightly overlapping distal ends.

The first syzygy is between brachials 3+4 and the second usually between brachials 9+10, though sometimes as early as brachials 7+8 or as late as brachials 14+15. The distal intersyzygial interval is from 3 to 16 (usually 9) muscular articulations.

P_1 is about 28 mm. long, and is composed of segments which for the most part are about as long as broad. It is basally more or less webbed with perisome, and tapers rapidly in its outer part. P_2 is slightly longer than P_1 and stouter, especially distally, the component segments being rather broader than long. The pinnules following resemble P_2 but decrease gradually in length to about the end of the proximal fourth of the arm, where they are only 14 mm. long. All of these pinnules except P_1 bear long fusiform gonads which reach nearly to their tips. In the second quarter of the arm the gonad diminishes in length and more and more of the distal part of the pinnule becomes slender; at the same time the pinnules gradually increase in length reaching 24 mm. in the middle of the arm, where they are composed of about 60 elongated segments. After the proximal half of the arm the pinnules become entirely slender and filiform, except for six or seven comparatively stout tapering proximal segments, and gradually decrease in length.

The disk is 25 mm. in diameter and is not incised.

The color is black with a trace of violet, or dark purple.

Notes.—The preceding description is taken mainly from Hartlaub, with a few additions furnished by the specimen in the United States National Museum labeled "South Pacific."

In the type specimen the centrodorsal has a slightly concave dorsal pole, and the cirri are XL–L, about 30, 30 mm. long. Hartlaub said that in this specimen the intersyzygial interval is 3 or 4 muscular articulations in the earlier portion of the arms, increasing distally to about 9. In the specimen from the "South Pacific" the intersyzygial interval is everywhere about 9 muscular articulations.

In this last specimen the arms are about 200 mm. long, and the cirri are XXXIV; the only six that are complete have 25, 29, 30, 33, 33, and 33 segments.

The specimen from Bowen in the Copenhagen Museum has the arms 190 mm. long and the cirri XXII, 21–25 (usually 24), 25 mm. long.

The color in life of the three specimens collected by Dr. Hubert Lyman Clark at Mer, Murray Islands, appeared at first sight black, but proved on close examination in bright light to be deep purple. One of these specimens is rather small, though typical, with the cirri XXIII, 22–23.

In the specimen from *Siboga* station 164 the centrodorsal is thick discoidal with the broad dorsal pole slightly concave, 9 mm. in diameter. The cirri are XXVII, 33–35, from 35 to 45 mm. long. The diameter of the animal at the level of the first syzygy is about 27 mm. The color is violet with large blotches of light yellow.

In the specimen from Port Galera, Mindoro, the cirri are rather long, though slender, with 31 segments. The color (dry) is purple with a very broad median stripe of yellow brown on the division series and arms.

One of the two specimens from between Fremantle and Geraldton has an arm length of about 220 mm. The centrodorsal is thick discoidal, 10 mm. in diameter basally and 4 mm. high interradially. The cirri are XXIII, 34–35, from 35 to 40 mm. long. The other is similar, with the arms 225 mm. long. The color in life was dark purplish brown.

Localities.—Bowen, Queensland [Hartlaub, 1890, 1891; A. H. Clark, 1907, 1908, 1909, 1911, 1912] (1, H. M.).

Bowen Queensland [A. H. Clark, 1909, 1911, 1912] (1, C. M.).

South Pacific (probably Queensland) [A. H. Clark, 1908, 1909, 1912] (1, U. S. N. M., 4015).

Mer, Murray Islands, Torres Strait; extreme margin of southwestern reef, among staghorn corals; H. L. Clark, October 1913 [H. L. Clark, 1921] (3. M. C. Z., 520, 567).

Siboga station 164; between New Guinea and Misool (lat. 1°42′30″ S., long. 130°47′30″ E.); 32 meters; sand, small stones, and shells; August 20, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Port Galera, Mindoro, Philippines; Dr. Lawrence E. Griffin (1, M. C. Z., 703).

Between Fremantle and Geraldton, Western Australia; 110–146 meters; *Endeavour* [A. H. Clark, 1914] (2, U.S.N.M., 35342; W. A. M.).

Geographical range.—From Mindoro, Philippine Islands, southward to Bowen, Queensland, and to between Fremantle and Geraldton, Western Australia.

Bathymetrical range.—From the shore line down to 110 (?146) meters.

Occurrence.—Dr. Hubert Lyman Clark said that the three individuals of this species that he found at Mer in the Murray Islands were all found among the staghorn corals of the extreme margin of the southwestern reef, a region accessible only at the lowest tides. They attracted attention by their very dark color, their extreme rigidity, and their inertness. Unlike the other comatulids watched under their natural conditions, these were erect and apparently rigid, firmly attached by the numerous long stout cirri to a branch of coral. There was no graceful movement of the arms, nor did they sway freely back and forth in the currents of water as did those of the large dark-colored *Comanthus* (*timorensis*) near by. In pail or basin at the laboratory *afra* remained most inert, making no effort to move and showing no response to mechanical stimuli.

History.—Dr. Clemens Hartlaub in 1890 first described this species under the name of *Antedon afra* from a specimen that had been brought from Bowen, Queensland, by the Godeffroy Company of Hamburg. Dr. C. F. Lütken had labeled this and another specimen from the same locality *Antedon afer*, and Hartlaub simply adopted Lütken's name. Hartlaub redescribed and figured the species in 1891. He said that this species belongs to the group of species of *Antedon* in which, as in *A. milberti*, there is no marked difference in length between P_2 and P_3. It is a very striking form because of its plump and massive build. Especially noteworthy are the common lack of an opposing spine, the discoidal brachials from which the first two stand out through their much larger size, and the strikingly abrupt and thread-like attenuation of the pinnules at the distal end of the gonad, which recalls the same feature in *Heliometra glacialis*.

In my first revision of the old genus *Antedon* published in 1907, *afra* was referred to the new genus *Tropiometra*. In a paper published on July 15, 1908, I mentioned a dried specimen of this species from the "South Pacific" in the collection of the United States National Museum and said that it agrees in all particulars with the seven specimens described therein from Sagami Bay (*macrodiscus*). It has rather more cirrus segments than did Hartlaub's type specimen, these numbering about 33, as given in Hara's description of *macrodiscus*. In a paper published on August 25, 1908, but written in advance of that just mentioned, I said that *afra* is quite distinct from the Japanese *macrodiscus*, but that I had been able to examine only one specimen of each. These were the dried specimen of *afra* from the "South Pacific" and a specimen of *macrodiscus* from Misaki recorded in April 1908 by Dr. Hubert Lyman Clark. In 1909 I described in detail a specimen from Bowen in the Copenhagen Museum that had been brought to Europe by the Godeffroy Company of Hamburg and bore the manuscript name *Antedon afer* given it by Prof. C. F. Lütken. I also gave notes on the dried specimen from the "South Pacific" previously mentioned, and said that it was intermediate in its characters between Hartlaub's type specimen and the one in the Copenhagen Museum from Bowen, and a specimen from Misaki—the one recorded by Dr. H. L. Clark.

In my memoir on the recent crinoids of Australia published in 1911 I said that *afra* is a large and stout species with arms usually somewhat over 200 mm. long which are rounded and perfectly smooth dorsally, and stout cirri with usually 30–35 or more segments. I said that so far as known the color is always either entirely yellow or entirely violet, never mottled. I remarked that only three Australian specimens are known, two from Bowen and one labeled "South Pacific" that probably came from Australia, and gave the range as from Queensland northward to southern Japan, showing that I considered *macrodiscus* a synonym of *afra*. I examined the type specimen of Hartlaub's *Antedon afra* at the Hamburg Museum in 1910 and recorded having seen it in 1912. In my memoir on the crinoids of the Indian Ocean published in 1912 I placed *macrodiscus* under the synonymy of *afra* and gave as the range of the latter Queensland to southern Japan in 0–50 fathoms. In my account of the crinoids collected by the *Endeavour* off the coast of Western Australia published in 1914 I listed *Tropiometra afra* as an Australian tropical species and recorded and gave notes on two specimens dredged between Geraldton and Fremantle. I remarked that, aside from these two specimens, this species (*macrodiscus* being considered as distinct) is represented in the museums of the world by only three specimens, two from Bowen, Queensland, brought to Europe by the Godeffroy Company more than fifty years before, and a third from the "South Pacific" brought back by the United States Exploring Expedition. In my account of the crinoids of west Africa published in 1914 I recognized *afra* and *macrodiscus* as distinct forms.

Dr. Hubert Lyman Clark wrote in 1915 that this species was not common at Mer, but a few individuals were found on the extreme outer margin of the southwestern reef-flat. He described their habits and reactions (see Part 2, p. 604).

In my report upon the unstalked crinoids collected by the *Siboga* expedition published in 1918, I recorded and gave notes on a specimen dredged between New Guinea and Misool which, I said, agreed with others at hand (the dried specimen from the "South Pacific" and the two from Western Australia) from Australia.

In 1921 Dr. Hubert Lyman Clark recorded three specimens that he had found in October 1913 at Mer and gave notes on their occurrence.

TROPIOMETRA AFRA MACRODISCUS (Hara)

PLATE 32, FIGURE 169

[See also vol. 1, pt. 1, fig. 65 (nerves), p. 91; fig. 319 (regenerating cirrus), p. 275; pt. 2, fig. 64 (radial pentagon), p. 33; fig. 279 (pinnules), p. 213; fig. 308 (proximal pinnules), p. 223; fig. 797 (ambulacral deposits), p. 372.]

Antedon macrodiscus HARA, Zool. Mag., Tokyo, vol. 7, No. 81, 1895, p. 115 (description; Misaki, 3 fms.).—[ANONYMOUS], Journ. Roy. Micr. Soc., 1895, p. 638; Nat. Sci., vol. 8, 1896, p. 10.—HAMANN, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 481 (related to *Antedon afra;* remarkable length of the lower pinnules).—KIRK, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 101, footnote (preponderance of females over males).—HARA and OKADA, Annot. Zool. Jap., vol. 10, art. 4, 1921, p. 33 (host of *Myzostoma ijimai*, new species).—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 9 (placed as a variety under *Tropiometra afra*).

Tropiometra macrodiscus A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 316 (considered as a synonym of *afra*).—H. L. CLARK, Bull. Mus. Comp. Zool., vol. 51, No. 11, 1908, p. 279 (Misaki; about 450 mm. in diameter; uniform deep yellow).—A. H. CLARK, Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (Misaki, 30–50 fms.; color; not a synonym of *afra*); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 125 (comparison with *T. afra*); Beiträge zur Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 312 (range); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. ix (relationship with *T. afra*), p. 131 (in key; range).—Mortensen, Studies in the development of crinoids, 1920, p. 26 (occurrence at Misaki).—A. H. Clark, Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 9 (nerves).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 92.

Tropiometra afra A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 315 (description of 7 specimens from Sagami Bay); Amer. Nat., vol. 42, 1908, p. 725 (in part; color); Geogr. Journ., Dec. 1908, p. 607 (in part; color); Vid. Medd. Naturh. Foren. København, 1909, p. 124 (specimen with 93 myzostomes), p. 185 (near the Goto Is., 36 fms.; Misaki); Crinoids of the Indian Ocean, 1912, p. 176 (Japanese localities).—Gislén, *in* Th. Mortensen, Hong Kong Nat. Suppl., No. 3, Feb. 1934, p. 6 (Hong Kong), pl. 8 (2 figs.).

Tropiometra afra var. *macrodiscus* Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 90 (Bock's station 27; notes).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 44, 51, 53, 78, 90; fig. 73, p. 75 (syzygial face), fig. 103, p. 89 (synarthrial face), figs. 158, 159, p. 98 (articulations of a left P_1); Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 30 (Mortensen's station 27; notes).

Tropiometra ofra macrodiscus Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 5 (Sagami Bay), pp. 7, 91, 93; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 39, 44, 51, 53, 78, 90, 275, 278 (Misaki, Japan, 2–3 m., food), p. 285 (Misaki, 0–3 m., details), p. 286; fig. 73, p. 75; fig. 103, p. 87; figs. 158, 159, p. 98; fig. 337, p. 277; fig. 338, p. 281; Journ. Fac. Sci. Imp. Univ. Tokyo, sect. 4, vol. 2, pt. 4, 1931, p. 433 (sparse in the *Heliocidaris* association).

Tropiometra encrinus Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5. No. 6, 1922, p. 4, (163 m.), p. 6 (Bonin Islands), p. 8, p. 92 (Bocks station 45; detailed notes), p. 182 (listed), figs. 70, 71, p. 88; Zool. Bidrag Uppsala, vol. 9, 1924, p. 41.

Diagnostic features.—A large stout form with the dorsal surface of the arms smooth, without any trace of a median carination. The cirri are XXIV–L (averaging about XXXV), 27–43 (usually about 35), 30–50 (usually about 40) mm. long. The arms are 120–265 (averaging about 200) mm. long.

This form is more robust and rugged than the preceding (*afra*) with somewhat longer and stouter cirri composed of more numerous segments.

Description.—The centrodorsal is a thick disk with slightly sloping sides. It is up to 12 mm. in diameter at the base with the broad dorsal pole 5–10 (averaging about 7.5) mm. in diameter, flat or slightly concave, sometimes marked with slight, low, and broad radiating ridges or broken lines. The cirrus sockets are arranged in from two to three irregular and crowded marginal rows.

The cirri are XXIV–L (averaging about XXXV), 27–43 (usually about 35), from 30–50 (usually about 40) mm. long. The cirrus segments are subequal from one-third again to twice as broad as long. There is usually no opposing spine, but occasionally a slight opposing spine may be present on some of the cirri. The terminal claw is a little longer than the penultimate segment. The cirri are stout, and usually become somewhat compressed laterally in the distal half.

The anterolateral angles of the radials are more or less extensively visible in the interradial angles of the calyx. The IBr_1 are oblong, broad, about six times as broad as long, with the lateral borders sharply flattened and closely appressed against those of their neighbors. The IBr_2 (axillaries) are broadly pentagonal or almost triangular, about twice as long as the IBr_1, three times as broad as long. The anterior angle is obtuse, and the lateral edges are straight, sharply flattened, and in close apposition with those of their neighbors. Low synarthrial tubercles are present.

The 10 arms are 120–265 (usually about 200) mm. long and resemble those of *T. afra*. They are stout basally but become very slender in the terminal portion.

Syzygies occur between brachials 3+4 and 9+10 (or 8+9), and distally at intervals of from 6 to 10 muscular articulations.

P_1 is 18–30 (averaging 22.6) mm. long, and is composed of 24–42 (usually about 30) segments. It is slender, becoming more or less flagellate distally. P_2 is 21–30 (averaging 25.7) mm. long with 30–42 (averaging 33) segments, and is somewhat stouter than P_1. P_3 is similar to P_2, 22–30 (averaging 25) mm. long, with 28–38 (averaging 33) segments. The pinnules following resemble these, but slowly decrease in length to the tenth or eleventh, P_{11} being about 12 mm. long. The distal pinnules are 12–18 (averaging 16) mm. long, and are composed of 30–45 (averaging 36) segments. They are comparatively stout basally but taper rather suddenly, becoming exceedingly slender after about the seventh segment. The second and following pinnules bear long fusiform gonads extending from about the fifth segment to near the tip of the pinnule. The first nine to eleven pinnules lack ambulacral grooves. Gislén noted that the relative size of the proximal pinnules is very variable. P_1, however, is always more slender than those following because of the absence of the gonad.

The disk is 22–29 (averaging 25) mm. in diameter. The diameter of the animal with the arms closed at the level of the first syzygy is 20–30 (averaging 24.5) mm.

The color is bright yellow or deep purple. One specimen is recorded as being dark yellow brown, and another as yellow with the cirri and arm bases washed with purple.

Notes.—One of the specimens from near Kowloon dock, Hong Kong, has the centrodorsal with the dorsal pole slightly convex. The cirri are XXVIII, 32–37, up to 45 mm. in length. Of the three specimens from this locality one is yellow, another is yellow with the cirri and arm bases washed with purple, and the third is entirely deep purple.

Three of the specimens from West Point, Hong Kong, are very large and stout, but the fourth is smaller. In one the centrodorsal is discoidal with the slightly concave dorsal pole 10 mm. in diameter. The cirri are XXXVI, 32–34. In another there is a single cirrus remaining which has 34 segments.

A specimen labeled simply Hong Kong is very large and stout. The longest cirri are 45 mm. long and are composed of 32–34 segments. The color is yellow.

The specimen from the Korean Straits has the arms 230 mm. in length. The cirri are XXVIII, 35-41, 40 mm. long. The pinnules are similar to those of specimens from Misaki. P_1 is 20 mm. long, and P_2 is 30 mm. long. P_3 is similar to P_2. The pinnules following gradually decrease in length. The distal pinnules are 17 mm. long. On some arms P_1 is more nearly the length of P_2.

In one of the specimens from Sagami Bay (lat. 37°07′ N., long. 139°44′ E.) the arms are 210 mm. long, and the animal is 30 mm. in diameter at the level of the first syzygy. The cirri are XXXVI, 37–43 (usually about 40), 50 mm. long. Two of the cirri have the distal portion broken off and regenerated, though the regenerated portion has not yet reached the normal stoutness. P_1 is 23 mm. long with 30–35 segments. P_2 is 24 mm. long, rather stouter than P_1, with a similar number of segments.

P_3 is similar to P_2. The pinnules following gradually decrease in length, P_6 being 22 mm. long, P_8 18 mm. long, and P_9 16 mm. long.

In a second specimen the arms are 180 mm. long, and the diameter at the level of the first syzygy is 25 mm. The cirri are XXIV, 34–38 (usually 37), 40 mm. long. The lower pinnules are all broken.

In a third specimen the arms are 170 mm. long, and the diameter at the level of the first syzygy is 23 mm. The cirri are XXV, 34–37 (usually nearer the latter), 40 mm. long.

In the fourth specimen the arms are 130 mm. long, and the diameter at the level of the first syzygy is 20 mm. The cirri are XXVIII, 34, 40 mm. long.

The specimen from Sagami Bay (lat. 35°15′ N., long. 139°48′ E.) has the arms 200 mm. long. The cirri are XXXV, 27–36 (usually about 33), 40 mm. long.

A specimen from off Misaki has the arms 210 mm. long. The cirri are XXVIII, 30–35 (usually 34), 40 mm. long. The pinnules resemble those of the specimen first described from Sagami Bay. The color (in formalin) is yellow.

The specimen from off Misaki taken in June 1903, has the arms 230 mm. long. The cirri are XXVIII, 29–35 (usually nearer the latter), 40 mm. long.

In the type specimen from Misaki as described by Hara the centrodorsal is a thick slightly concave disk bearing the cirri in about three rows. The cirri are about XLVI, 33; the cirrus segments are tolerably uniform, all broader than long, especially those at the base. The middle and outer segments are slightly compressed laterally. The edges of the cirrus segments are smooth. The radials are scarcely visible. The IBr_1 are quadrate, convex, with a median tubercle at the junction with the axillaries. The IBr_2 (axillaries) are widely triangular (or broadly pentagonal with very short sides adjacent to the base) and are twice as long as the IBr_1. The 10 arms are more than 150 mm. in length, and consist of about 150 or more brachials. There is a tubercle at the junction of the first and second, and of the second and third. The first syzygial pair and the next following brachials are smooth, rounded, and oblong. The lower brachials have alternating tubercular elevations at their junctions. The outer brachials are obliquely triangular, gradually changing to short quadrate, much broader than long. Syzygies occur between brachials 3+4 and 9+10, and distally at intervals of 6–10 muscular articulations. P_1 and P_a are 12 mm. long and consist of 8–12 segments of which the lower are as long as broad and slender. The middle pinnules are tolerably uniform, 22–25 mm. long, and consist of 28–30 segments all of which are broader than long, smooth, and rounded; they taper to a filiform end from the stout base. The outer pinnules gradually diminish in length and stoutness, becoming filiform. They have smooth quadrate segments which are broader than long at the base and as long as broad near the end. The disk is 24 mm. in diameter, and is naked. Sacculi are abundant. The color in life is shining dark purple, in alcohol dark reddish brown.

Of the three specimens collected by Dr. Th. Mortensen at Misaki in 1.8 meters one had the cirri XXIX, 38-43, from 40 to 55 mm. long and the arms 240 mm. long, and another had the arms also 240 mm. long.

One of the specimens from Misaki in 55–91 meters in the Hamburg Museum is purple in color, and resembles the specimens from Japan in the United States National Museum and in the Copenhagen Museum. The other is similar, but slightly smaller.

The specimen from Misaki recorded by Dr. H. L. Clark has the arms about 225–230 mm. long. The cirri are XXVIII, 29–35. The color in alcohol is uniform deep-yellow.

One of the two specimens from Sagami Bay collected by Prof. Franz Doflein has the arms 230 mm. in length and the cirri XLVIII, 37–43, the longest about 55 mm. long. The dorsal pole of the centrodorsal is 7 mm. in diameter. The color in alcohol is a uniform dark yellow brown. This is a magnificent and quite typical specimen. The second specimen is similar, but smaller. The arms are 200 mm. long, and the cirri are 40 mm. long and are composed of 29-30 segments. The color is deep purple.

The nine specimens from Bock's station 27 according to Dr. Torsten Gislén show the following characters:

1. The centrodorsal is discoidal, the flat dorsal surface, which is 10 mm. in diameter, showing slight radiating swellings. The cirri are arranged in two rows. The cirri are XLIII, 36–39, about 40 mm. long. The cirrus segments are subequal, about as long as broad, or from one-half to one-third again as broad as long. The terminal claw is a little longer than the penultimate segment. The apical cirri are shorter than the others, and have fewer segments. The radials project somewhat beyond the centrodorsal in the interradial angles. The IBr_1 are six times as broad as long, and are in close lateral apposition. The IBr_2 (axillaries) are three times as broad as long, pentagonal or almost triangular, with a small median tubercle well marked off from the IBr_1. They are in close lateral apposition. The articulations between the proximal ossicles are indistinct. These proximal ossicles are flattened and granular as is often the case, according to Gislén, in *Oligometrides*. The 10 arms are 190–210 mm. long. The first brachials are 5.5 mm. broad, and are united interiorly. The first two brachials are twice as long exteriorly as interiorly. All the distal brachials are short and discoidal, four times as broad as long. There are 14 brachials for each 10 mm. of arm length, or 12 if the syzygial pairs are counted as units. On one arm taken as a sample syzygies occur between brachials 3+4, 8+9, 13+14, 30+31, 39+40, 50+51. On another they occur between brachials 3+4, 9+10, 15+16, 28+29, 41+42, 51+52. The distal intersyzygial interval is about 8 muscular articulations. P_1 is 20 mm. long with 25–27 segments. P_2 is 26 mm. long with 34 segments which are half again as long as broad. The pinnules from P_2 to P_{10} are larger and stouter than the pinnules following, and decrease slowly in length. The ambulacral furrow does not appear until P_9 or P_{11}, except on one arm that is shorter than the others. The distal pinnules are 15 mm. long with about 35 segments which are from half again to twice as long as broad, and of which the last 3–5 have weak dorsal hooks. The disk is 22 mm. in diameter. The mouth is subcentral. The anal cone is 5 mm. long. The color is dark chocolate-violet.

2. The dorsal pole of the centrodorsal is 5 mm. in diameter. The cirri are XXX, 34–40, from 30 to 50 mm. long. The arms are 150–180 mm. long. P_1 is 22 mm. long with about 30 segments. P_2 has about 30 segments. The distal pinnules are 14 mm. long with about 30 segments. The pinnules of the first eleven pairs are without ambulacral grooves.

3. The dorsal pole of the centrodorsal is 7 mm. in diameter. The cirri are XLV, 34–38, from 32 to 42 mm. long. The arms are 130–250 mm. long. P_1 is 26 mm. long with 34 segments. P_2 is 30 mm. long with 42 segments. The distal pinnules

are 16–18 mm. long with 40–45 segments. The pinnules of the first ten pairs are without ambulacral grooves.

4. The dorsal pole of the centrodorsal is 7 mm. in diameter. The cirri are XXXVI, 37–40, from 35 to 42 mm. long. P_1 is 24 mm. long with 24–28 segments. P_2 is 27 mm. long with 33 segments. P_3 is 22 mm. long with 28 segments. The distal pinnules are 15 mm. long with about 35 segments. On one arm there are syzygies between brachials 3+4, 9+10, 18+19, 28+29, 36+37, 42+43, 48+49, 54+55, 59+60, 69+70, 77+78, 82+83, and 99+100.

5. The dorsal pole of the centrodorsal is 9 mm. in diameter. The cirri are XXXIII, 36–41, from 30 to 40 mm. long. The arms are 120–180 mm. long. P_1 is 21 mm. long with 34 segments. P_2 is 21 mm. long with 32 segments. The distal pinnules are 14 mm. long with 35 segments. The pinnules of the first five to eight pairs are without ambulacral grooves. The disk is 26 mm. in diameter.

6. The dorsal pole of the centrodorsal is 6 mm. in diameter. The cirri are XXXIV, 38–40, about 40 mm. long. The arms are 150–220 mm. long. P_1 is 18 mm. long with 26 segments. P_2 is 23 mm. long with 30 segments. P_3 is 23 mm. long with 33 segments. The distal pinnules are 12 mm. long with 33 segments. The first eleven to sixteen pinnules are without ambulacral grooves. The disk is 25 mm. in diameter.

7. The dorsal pole of the centrodorsal is 7 mm. in diameter. The cirri are L, 33–38, from 35 to 45 mm. long. The arms are 180–240 mm. long. P_1 is 23 mm. long with 35 segments. P_2 has 25+ segments. P_3 is 30 mm. long with 38 segments. The distal pinnules are 18 mm. long with 37–40 segments. The first nine to eleven pinnules are without ambulacral grooves.

8. The centrodorsal is 12 mm. in diameter, with the dorsal pole 9 mm. across. The cirri are XLII, 28–40, from 30 to 50 mm. long. Some of the cirri have a slight opposing spine. The arms are 245–265 mm. long. P_1 is 25–30 mm. long with 33–42 segments. P_2 is 25–30 mm. long with about 35 segments. The distal pinnules are 18 mm. long with 36 segments. The first eight pinnules are without an ambulacral groove. The disk is 29 mm. in diameter. This specimen has two very large *Myzostomas* in the pharynx.

9. The dorsal pole of the centrodorsal is 7.5 mm. in diameter. The cirri are XXXVI, 28–39, from 38 to 45 mm. long. The arms are 190–215 mm. long. P_1 is 18 mm. long with 27 segments. P_2 is 21 mm. long with about 30 segments. The distal pinnules are 18 mm. long with 32 segments. The first nine to eleven pinnules are without ambulacral furrows. The disk is 24 mm. in diameter.

In a specimen from the Bonin Islands, as described by Gislén, the centrodorsal is flattened with the free dorsal pole 2 mm. in diameter and marked with scars representing the obsolete sockets of discarded cirri. The cirri are XX, 25–29, from 18 to 24 mm. in length, and are arranged in two rows. The cirrus segments are uniform, twice as broad as long, becoming half again as broad as long distally. The antepenultimate segment is as long as broad. The opposing spine is represented by an indistinct prominence. The terminal claw is half again as long as the segment that bears it, and is curved and pointed. One of the cirri is regenerated from the eleventh segment. The radials are four times as broad as long, and are longest in the interradial angles of the calyx. The IBr_1 are three times as broad as long and are free laterally. The IBr_2 (axillaries) are triangular, three times as broad as long. The 10 arms are 105 mm. long. The first brachials are 2.7 mm. long, twice as long exteriorly as interiorly, interiorly united for one-third of their length. The second brachials are twice as long exteriorly as interiorly. The brachials are distally somewhat overlapping, giving the distal portions of the arm a somewhat serrate profile. There are 15 brachials for each 10 mm. of arm length, or 12–13 if the syzygial pairs are counted as units. The proximal portion of the arms is smooth, and a little flattened. The elements of the IBr series have a sharp lateral edge, but never a mediodorsal carination. Syzygies occur between brachials 3+4, 8+9 (or 9+10), and 16+17, and distally at intervals of from 5 to 9 muscular articulations. P_1 is 12.5 mm. long with 24–25 segments of which the second-fourth have a slight keel on the side toward the arm tip. P_2 is similar to P_1. P_3 is 12 mm. long with 25 segments. P_5 is 11 mm. long with 21 segments. P_8 is 8 mm. long with 23 segments. P_1 to P_5 are without ambulacral furrows, larger and stouter than the other pinnules, and carry gonads. But the difference is not so marked as it is in *T. afra macrodiscus*. The distal pinnules are 14 mm. long with about 30 segments of which the first two or three are short and the remainder are from half again to twice as long as broad. The disk is 13 mm. in diameter. The color is red-violet.

Localities.—Near Kowloon Dock, Hong Kong; Dr. G. A. C. Herklots (3, U. S. N. M., E. 3210; C. M.).

West Point, Hong Kong; Dr. G. A. C. Herklots (4, U. S. N. M., E. 3212).

Hong Kong; Dr. G. A. C. Herklots [Gislén, in Th. Mortensen, 1934].

Hong Kong; Dr. G. A. C. Herklots (2, U. S. N. M., E. 3211).

Korean Straits, near the Goto Islands (lat. 33° 08′ N., long. 129° 20′ E.); 66 meters; Captain Schønau, March 14, 1890 [A. H. Clark, 1909] (1, C. M.).

Sagami Bay, Japan (lat. 37° 07′ N., long. 139° 44′ E.); 38 meters; Alan Owston, November 11, 1901 [A. H. Clark, 1908] (4, U. S. N. M., 35336, 35344, 36238 [original No. 5915]).

Sagami Bay (lat. 35° 15′ N., long. 139° 48′ E.); 18 meters; Alan Owston, November 23, 1902 [A. H. Clark, 1908] (1, U. S. N. M., 35406 [original No. 7285]).

Sagami Bay; off Misaki; Alan Owston [A. H. Clark, 1908] (1, U. S. N. M., 35405 [original No. 8139]).

Sagami Bay; off Misaki; Alan Owston, June 1903 [A. H. Clark, 1908] (1, U. S. N. M., 35404).

Misaki; 5 meters [Hara, 1895; Anonymous, 1895, 1896; A. H. Clark, 1907, 1908].

Misaki; 55–91 meters; Alan Owston [A. H. Clark, 1912] (1, H. M.).

Misaki; 55–91 meters; Alan Owston [A. H. Clark, 1912] (1, H. M.).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; station 27; Misaki; 1.8 meters; rocky bottom; July 1914 [Gislén, 1927].

Misaki; *Albatross*, 1906 (1, U. S. N. M., 35343).

Misaki; Alan Owston [H. L. Clark, 1908] (1, M. C. Z., 337 [original No. 8140]).

Misaki [Kirk, 1911].

Misaki [Mortensen, 1920].

Misaki (2, U. S. N. M., 39154).

Near Misaki; 10–20 meters; Prof. Franz Doflein, October 19, 1904 (2, Munich Mus.).

Dr. Sixten Bock's expedition to Japan station 27; Misaki, Sagami Bay; 5–9 meters (diver); June 14, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 45; Bonin Islands, east of Chichijima; 164 meters; July 31, 1914 [Gislén, 1922, 1924].

Geographical range.—From Hong Kong northward to the Korean Straits and eastward to Sagami Bay, Japan, and the Bonin Islands.

Bathymetrical range.—From the low tide mark down to 66 (?91) meters. Doctor Bock's record of 164 meters represents the amount of line out, not the actual depth.

Occurrence.—Hara said that this form is very common along the Japanese coast near Misaki, together with *Comanthus japonica*, and Mortensen (1920) noted that at Misaki it is common in the same localities as the large *Comanthus*.

It is common at Hong Kong.

Preponderance of females over males.—Dr. Edwin Kirk wrote that the preponderance of females over males seems to be quite marked in recent crinoids. Among nearly 30 specimens of *Comanthus japonica* collected at a single locality at one time there were no males. The females in all cases bore large numbers of nearly ripe ova. At the same locality *Tropiometra macrodiscus* likewise showed a very marked preponderance of females over males.

The locality referred to by Dr. Kirk is Sagami Bay, Japan, where the specimens, which were identified by the present author, were collected by the late Dr. Bashford Dean.

Parasites.—From the specimen recorded from Misaki by Dr. H. L. Clark I removed no less than 93 rather large myzostomes (see Part 2, p. 654), and there is no way of estimating how many may have dropped off during or subsequent to capture. These myzostomes were clinging to the disk and gonads, and were lodged between the lower pinnules. In the basal quarter of the arm there was at least one myzostome on every gonad.

History.—This form was originally described in July 1895 under the name *Antedon macrodiscus* by Jiuta Hara from a specimen taken at Misaki, Japan, in 3 fathoms. Mr. Hara said that *Antedon macrodiscus* resembles *A. milberti* in the character of the tubercular radials and of the stout round segments of the lower pinnules, as well as in the form of the brachials and in the intersyzygial interval. But it differs from that species in the absence of spines on the cirri and in the discoidal form of the centrodorsal. He noted that the number of cirri is different, although this may be a trifling matter. To *Antedon carinata* it bears a certain resemblance in the form of the centrodorsal, radials, brachials, and lower pinnules. But it differs decidedly from that species in the absence of carination on the arms and on the first two brachials. From *Antedon rosacea* (=*bifida*) it may be distinguished by the difference in the intersyzygial interval, by the number of cirrus segments, and by other characters. Mr. Hara said that this species has a certain alliance to the three species named, but there are certain important points of difference by which it can readily be distinguished from them.

Upon the establishment of the genus *Tropiometra* in 1907 *macrodiscus* was referred to it.

In April 1908, Dr. Hubert Lyman Clark recorded under the name of *Tropiometra macrodiscus* and gave notes on a specimen from Sagami Bay collected by Alan Owston that had formed part of an interesting lot of echinoderms secured for the Museum of Comparative Zoology by Dr. Thomas Barbour. Dr. Clark graciously remarked that the specimen had been identified for him by the author, whom he permitted to make notes upon it.

On July 15, 1908, I recorded and gave notes upon seven specimens identified as *Tropiometra afra* that had been dredged in Sagami Bay by Alan Owston in his yacht the *Golden Hind* and subsequently purchased and deposited in the United States National Museum by Frank Springer. I remarked that I could not find any tangible differences between the Japanese form described in 1895 by Hara as *macrodiscus* and the Australian *afra* described by Hartlaub two (in reality five) years earlier, of which the National Museum possesses a dried specimen from the South Pacific. I noted that the latter agrees in all particulars with the Japanese specimens, and has rather more cirrus segments than does Hartlaub's type specimen, these numbering about 33, as given in Hara's description of *macrodiscus*. In a paper published on August 25, 1908, I wrote under the heading *Antedon macrodiscus* that "The affinities of this remarkable species are with *Antedon afra* Hartlaub, from which, however, it is quite distinct, the length of the lower pinnules being especially remarkable. It is strange that specimens of these two species should be so rare in collections. I have only been able to examine one of each." The two specimens referred to were the specimen of *macrodiscus* recorded by Dr. H. L. Clark in April 1908, and a specimen of *afra* in the United States National Museum labeled "South Pacific" that had been collected by the United States Exploring Exedition.

In 1909 I recorded under the name *Tropiometra afra* and gave notes upon a magnificent specimen of this comatulid from the Korean Straits and also gave notes on another from Misaki which, although the fact is not mentioned, was the one recorded in 1908 by Dr. H. L. Clark. I wrote that, judging from Hartlaub's type specimen of *afra* from Bowen and a second from Bowen here recorded and described, it would seem that the large and rugged specimens from Japan, the *macrodiscus* of Hara, with their more numerous cirrus segments, were certainly specifically distinct. But a specimen taken by the United States Exploring Expedition in the "South Pacific" (probably Australia) so unites the two forms that we can not but consider them identical. I noted that the number of cirrus segments in this specimen and in the one from Misaki are approximately the same, thus rendering the separation of the two impossible so far as this character is concerned, and I could find no differences in the arm and pinnule structure. I added that the Australian material available is scanty and unsatisfactory, and more perfect specimens may possibly show some grounds for the recognition of two forms; but it certainly cannot be done as matters stand now, and, considering the enormous range of the only other species of the genus (*carinata*, considered as including all the smaller forms with carinate arms), it appears most probable our present conclusions are correct. In my memoir on the Recent crinoids of Australia published in 1911, I included *macrodiscus* as a synonym under *afra*, saying that it is common in the Korean Straits and abundant at Misaki.

In 1912 I recorded, under the name *Tropiometra macrodiscus*, two specimens I had examined at the Hamburg Museum in 1910 and said that I was now convinced I had been wrong in placing Hara's *macrodiscus* in the synonymy of Hartlaub's *afra*; *macrodiscus* is a stouter and larger form than *afra*, with longer and heavier cirri and longer brachials. A glance at the cirri alone is sufficient to distinguish them. At the time this was written, in Hamburg, I had before me Hartlaub's type specimen of *afra* as well as the two specimens of *macrodiscus*. In my account of the crinoids of west Africa published in 1914 I maintained *macrodiscus* as distinct from *afra*. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918, I listed *Tropiometra macrodiscus* as the Japanese representative of the southern *T. afra*, and in the key to the species of *Tropiometra* gave its habitat as southern Japan.

Dr. Th. Mortensen in 1920 said that at Misaki *Tropiometra macrodiscus* is common in the same localities as the large *Comanthus*.

In 1922 Dr. Torsten Gislén gave detailed notes upon nine specimens from Misaki that had been collected by Dr. Sixten Bock in 1914. These he recorded under the name *Tropiometra afra* var. *macrodiscus*. Citing me, he wrote that *macrodiscus* differs from *T. afra* in its longer and stouter cirri, which have more numerous segments. This difference is also to be found in those that were brought home by Dr. Bock's expedition. Nevertheless he cannot consider that a form that differs only in a characteristic of such a low systematic value as this is to be counted as more than a variety. Besides, one must bear in mind, according to Dr. Gislén, that *T. macrodiscus* is only known from Sagami Bay [it was at the time also recorded from the Korean Straits], while *T. afra* is known from the coasts of Africa [there are no African records; he was probably led astray by the name], Australia, and New Guinea. Therefore it is very probable that transition forms may be brought home from the intervening territory. He asks the reader to compare my descriptions of specimens from Sagami Bay, which are not very different from *T. afra*. Accordingly he is of the opinion that the differences between *macrodiscus* and *afra* cannot be given more than the value of those of a variety. With this conclusion I am in complete accord.

Under the name *Tropiometra encrinus* Dr. Gislén in 1922 described a specimen from the Bonin Islands that appears to be a young individual of the present form. He says that the proximal portions of the arms are smooth and a little flattened, which applies to *macrodiscus* but not to *encrinus* in which the earlier brachials are roundedly carinate. *Tropiometra encrinus* is not definitely known from farther east than Java. In 1924 Dr. Gislén described various structural features of the arms and pinnules of this form. In 1927 he recorded and gave notes upon three specimens that had been collected by Dr. Th. Mortensen at Misaki.

In 1934 Dr. Th. Mortensen included *Tropiometra afra* in a list of the echinoderms of Hong Kong, the identification having been made for him by Dr. Torsten Gislén. He gave figures of two specimens from this locality.

TROPIOMETRA CARINATA CLARKI Gislén

Plate 34, Figures 175–179; Plate 35, Figures 180–182

[See also vol. 1, pt. 2, figs. 60, 61 (radial pentagon), p. 33.]

Antedon carinata (part) P. H. Carpenter, Notes Leyden Mus., vol. 3, 1881, p. 179 (Indian Ocean; notes); Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 502 (Java; characters of the pinnules); *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 137 (Java); vol. 26, pt. 60, 1888, pp. 200, 202 (Java).—Bell, Proc. Zool. Soc. London, 1888, p. 387 (Sea of Bengal).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 371 (?Java).

?Antedon marmorata (Vienna Mus., MS.) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 202 (Norfolk Island; *nomen nudum*).

Tropiometra carinata (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (included under this name up to 1911); Vid. Medd. Naturh. Foren. København, 1909, p. 182 (East Indies; characters).

Tropiometra sp. A. H. Clark, Amer. Nat., vol. 42, No. 500, 1908, p. 541 (known only from the Indo-Pacific-Japanese area); Notes Leyden Mus., vol. 33, 1911, p. 189 (Indian Ocean).

Antedon encrinus (Lütken, MS.) A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 117 (synonym of *T. carinata*).

Alecto encrinus (Lütken, MS.) A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 182 (in synonymy of *Tropiometra carinata*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 36 (in synonymy of *Tropiometra encrinus*); Crinoids of the Indian Ocean, 1912, p. 177 (same).

Tropiometra encrinus A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 36 (in part; east coast of Asia); Notes Leyden Mus., vol. 33, 1911, p. 189 (comparison with *Tropiometra*, sp., from the Indian Ocean); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 440 (East Indian species); Mem. Australian Mus., vol. 4, 1911, p. 722 (range in Australia unknown), p. 735 (in key), p. 780 (no definite Australian records; Norfolk Island); Rec. Indian Mus., vol. 7, pt. 3, 1912, No. 26, p. 270 (Sadras [=Madras]); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 29 (Java; specimen not seen); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity), p. 402 (comparisons with related species; eastern Asia; Indian Ocean; ?India; descriptions); Crinoids of the Indian Ocean, 1912, p. 177 (in part; east coast of Asia; Java), fig. 29, p. 178 (type specimen); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in eastern Asia); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 313 (range; ?India; East Indies; eastern Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance).—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 85 (Ceylon; 2 characteristic specimens), p. 93 (occurs at Ceylon).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 131 (in key; range).—Gislén, Ark. Zool., vol. 19, No. 32, 1928, p. 6 (little different from *T. picta*).—A. H. Clark, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 560 (Pamban Beach; near Mandapam; Madras; Waltair; detailed description and notes), pl. 19, figs. 10–12; pl. 20, figs. 13–17.—Gislén, Vid. Medd. Dansk. Naturh. Foren. København, vol. 93, 1933, p. 478 (validity), fig. 4, p. 477 (figure of cirrus).

Tropiometra clarki Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 4 (listed), p. 16 (new name for the form represented by the specimen from Mandapam described in detail in Clark, 1932, p. 561).

Diagnostic features.—The carination of the arms is slight in the proximal half, and entirely absent or only very faintly indicated in the distal half; the cirri are rather large, XX–XXXIII (usually about XXV), 19–34 (averaging 25), from 20 to 35 (averaging 24) mm. long; the arms are up to 180 mm. in length, though rarely exceeding 150 mm.

Description.—The centrodorsal is a thin to rather thick disk with the broad dorsal pole 5–6 mm. in diameter, flat or slightly concave, more or less marked with faint radiating lines, and toward the periphery raised at the bases of the larger cirri., The cirri are arranged in one and a partial second, two, or two and a partial third marginal rows.

The cirri are XXV, 29–34 (usually 32–33), from 30 to 35 mm. long. The first segment is very short, commonly a thin disk from six to eight times as broad as long, and the second is between two and two and one-half times as broad as long. The segments following may remain subequal, between half again and twice as broad as long, or they may become somewhat longer on the fifth-ninth or sixth-tenth, and shorter again in the distal half of the cirri. The distal edge of the cirrus segments in lateral view is very strongly sinuous. The cirri may remain uniform in width, as viewed laterally, until the last six or eight segments, on which they taper to the tip; or they may taper very gradually in the distal half, third, or fourth; sometimes they broaden almost imperceptibly from about the eighth segment, slowly tapering in the distal fourth. The antepenultimate segment is small, wedge-shaped, slightly broader than the ventral length. The terminal claw is about half again as long as the antepenultimate segment, and is rather stout and moderately and evenly curved.

The radials are just visible beyond the rim of the centrodorsal, or they are concealed in the midradial line, their anterolateral angles being visible in the interradial angles of the calyx where the anterolateral angles of adjacent radials form together a low triangle of which the very sharp lateral angles almost or quite meet in the midradial line. The IBr_1 are exceedingly short, from six to eight times as broad as long, and may be partially concealed by the centrodorsal. They are in lateral contact. Their proximal and distal borders are slightly prominent. The IBr_2 (axillaries) are triangular, twice as broad as long, with the distal sides slightly or moderately concave. The proximal half of the midradial line of the axillaries and the adjacent portion of the IBr_1 are raised into a small, low, and very broadly rounded, often obscure, synarthrial tubercle.

The 10 arms are about 180 mm. long. The first two brachials are markedly larger than those succeeding, this being especially true of the second. The first brachials are wedge-shaped, half again as long exteriorly as interiorly, and more or less completely united interiorly. The second brachials are triangular, with the outer edge more or less longer than the outer edge of the first brachials, and the inner edge reduced to a point. The first syzygial pair (composed of brachials 3+4) is wedge-shaped, slightly more than twice as broad as the median length; the hypozygal (third brachial) is very short and band-like, with the proximal and distal borders parallel. The inner edge of the epizygal (fourth brachial) is as long as, or slightly longer than, the inner edge of the hypozygal, but the outer edge is reduced to a point. The next four brachials are oblong, about four times as broad as long. After the second syzygy the brachials are triangular, short, about four times as broad as the median length, with a small rounded triangular projection in the mid-dorsal line and a prominent angle deeply incising the proximal border of the succeeding brachial halfway between the mid-dorsal line and the base of the pinnule. After about the thirtieth the brachials become wedge-shaped again, and after the proximal third of the arm slowly increase in length so that the terminal brachials are longer than broad with slightly oblique ends. The distal ends of the brachials are marked with exceedingly fine longitudinal striations, and the distal edges are very finely spinous. On the distal brachials most of the dorsal surface is marked with fine striations. The first two brachials have a broad but very low and somewhat obscure median carination. On the brachials succeeding this is narrowed, becoming a fine low narrow line with the distal portion somewhat elevated, so that the dorsal profile of the arm is strongly serrate. This carination becomes obscure after the proximal fourth of the arm, and in the outer half of the arm completely disappears, the dorsal profile of the arm becoming entirely smooth.

Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of from 4 to 9 (usually 6) muscular articulations.

P_1 is 15 mm. long, moderately stout in the proximal half, becoming slender in the distal half. It is composed of 25 segments of which the first is half again as broad as long, the second is twice as broad as long, the third is half again as broad as long, and those following gradually increase in length, becoming about as long as broad in the middle of the pinnule, and twice as long as broad terminally. The pinnule is strongly prismatic, and when viewed from the side toward the arm tip shows a well marked, though low, longitudinal crest. P_2 is of about the same length as P_1 and is composed of 25 segments. It resembles P_1 but tapers more gradually so that it appears somewhat stouter in the distal half. P_3 is 15 mm. long with 26 segments, slightly stouter than P_2 with a somewhat more prominent dorsal crest and with the distal ends of the segments on the side toward the arm base slightly produced. It bears a long fusiform gonad extending to the sixteenth segment. The next three or four pinnules are similar, and those following very slowly decrease in length, the twentieth being 9 mm. long with 23 segments. The distal pinnules are exceedingly slender and hairlike, about 20 mm. long with 57 segments.

The disk is 25 mm. in diameter and is not incised. The five ambulacral grooves running from the mouth usually fork about halfway between the mouth and the periphery of the disk, though sometimes nearer the latter. In two specimens the individual arms of the anterior and right anterior pairs are supplied with grooves arising directly from the peristome, so that seven groove trunks radiate from the mouth, three forking and four remaining undivided.

The color in alcohol is purplish brown, with the arms in the outer half or two-thirds narrowly and abundantly banded with dull orange-yellow.

Notes.—The preceding description is based upon five specimens from near Mandapam.

In the specimen from Pamban Beach the cirri are XXV, 26; the cirrus segments are subequal, usually about half again as broad as long, but in some cirri nearly or quite twice as broad as long.

In one of the specimens from Madras, station 5 (No. 14), the cirri are XXV, 26, from 25 to 27 mm. long. All the cirrus segments are subequal, all being about twice as broad as long. The lower brachials have a narrow but well developed median carination which rises rapidly from the proximal to the distal end so that in lateral view the dorsal profile of the arms is very strongly serrate. After the proximal quarter of the arms this gradually dies away, becoming obsolete and almost completely disappearing in the outermost portions of the arms, though very faint suggestions of it remain. The color is light purplish brown finely mottled with dull yellowish, most abundantly on the division series and proximal fourth of the arms. The cirri are dull yellowish, becoming more or less brownish ventrally.

In another specimen from Madras, station 5 (No. 33), the cirri are XXV, 23–24, from 20 to 22 mm. in length. The cirrus segments are subequal, half again as broad as long, or twice as broad as long, or the earlier segments are from half again to twice as broad as long and the distal portion of the cirri is slightly broadened in lateral view, with the segments shorter, up to two and one-half times as broad as long. The color is light dull yellowish, the arms mottled with purplish brown for the first 20–25 mm., then narrowly banded, the bands involving two or three brachials and being separated by four or five.

In a third specimen from Madras, station 5 (No. 34), the cirri are XXIII, 26–27, 20 mm. long. The cirrus segments are subequal, all about twice as broad as long. The arms are 150 mm. long.

In the fourth specimen from Madras, station 5 (No. 42), the cirri are XXV, 19–24, from 15 to 18 mm. long. The segments are subequal, half again as broad as long, or twice as broad as long, or somewhat shorter distally than proximally. The color is dull yellowish, the arms narrowly and frequently banded with purplish, becoming mottled on the arm bases.

The two specimens from Madras originally recorded as from Sadras are of medium size.

In the specimen from Waltair the cirri are XXX, 16–19. The cirrus segments are subequal, half again as broad as long, slightly longer or slightly shorter. The arms were probably about 75 mm. long.

The five specimens from ?India are all of medium size. One of these has the median brachial carination exceptionally well developed. In another the cirri are XX, 23–25, from 20 to 25 mm. long and resemble those of the type specimen.

The two specimens recorded by Dr. Hubert Lyman Clark from Ceylon are characteristic of the species. In one of them the dorsal pole of the centrodorsal is 7 mm. in diameter. The cirri are XXXIII, 27–29. All the cirrus segments are short, as in *carinata*, and the cirri are of uniform width throughout.

Carpenter said that the Leyden Museum contains a small and mutilated specimen from the Indian Ocean that differs from the specimens obtained at Mauritius in the somewhat larger relative size of the lower pinnules, and in the greater smoothness of the outer portion of the arms. The author examined this specimen at Leyden in 1910. The cirri are XV, 18–22, comparatively weak and slender. The cirrus segments are all subequal, all slightly broader than long, the last four tapering slightly. The brachial carination is moderate.

The specimen from the Indian Ocean in the Berlin Museum is much broken. The centrodorsal and calyx have been laid open, showing beautifully the relationships of the dorsal cavities of the calyx.

Carpenter said that the four specimens from Java that he examined at the Hamburg Museum are more like specimens from Mauritius (*carinata*) than they are like two others without locality, having XX–XXV cirri and more slender pinnules; but the later pinnules are much less stiff than usual so that the arm ends have a more feathery appearance than is the case in the form (*carinata*) from Mauritius.

The specimen from the East Indies in the Copenhagen Museum has the brachial carination but slightly marked. This specimen, and two others without locality, are peculiar in being white. Presumably they were yellow in life.

In the specimen from Eastern Asia the cirri are large and stout, XXIII, 20–23 (usually nearer the latter), from 20 to 25 mm. in length. In the proportions of the component segments the cirri resemble those of *T. carinata*.

Localities.—Pamban Beach, Ramnad District, Madras Presidency; in dead corals; Drs. B. Chopra and H. S. Rao, February, 1925 [A. H. Clark, 1932] (1, I. M.).

Near Mandapam (or Mandapan), Madras Presidency (lat. 9°17′ N., long. 79°12′ E.); 4–7 meters; September 15, 1925 [A. H. Clark, 1932] (5, U. S. N. M., E. 3275; I. M.).

Madras [A. H. Clark, 1912 (as Sadras)] (2, I. M.).

Madras; station 5; harbor; 9 meters; Dr. S. W. Kemp, May 3, 1918 [A. H. Clark, 1932] (4, I. M.).

Waltair, about 3 miles north of Vizagapatam; station 1; rocks and beach south of Lawson's Bay; Dr. S. P. Agharkar, January 22, 1921 [A. H. Clark, 1932] (1, I. M.).

?India [A. H. Clark, 1912, 1914] (5, U. S. N. M., 35420 [original No. 3H], 35421 [original No. 28H], 35424 [original No. 29H], 35426 [original No. 33H]; I. M.).

Sea of Bengal [Bell, 1888].

Ceylon [H. L. Clark, 1915] (2, M. C. Z., 607; Colombo Mus.).

Indian Ocean [P. H. Carpenter, 1881; A. H. Clark, 1909, 1911, 1912] (1, L. M.).

Indian Ocean [A. H. Clark, 1912] (1, Berl. Mus., 5335).

Java [P. H. Carpenter, 1882, 1884, 1888; Hartlaub, 1912; A. H. Clark, 1912].

East Indies [A. H. Clark, 1909, 1912, 1914] (1, C. M.).

Eastern Asia (East coast of Asia) [A. H. Clark, 1911, 1912, 1914] (1, Berl. Mus., 5336).

No locality [A. H. Clark, 1909] (3, C. M.).

Note.—The specimens labeled Indian Ocean, East Indies, and eastern Asia agree in their characters with others definitely known to be from the eastern coast of India. There can be little doubt that they really came from that region where this form is locally common and where many collections have in the past been made.

Erroneous localities.—Sadras, India [A. H. Clark, 1912, 1932]. In reality Madras; see above.

Fiji [Minckert, 1905 (locality not given); Hartlaub, 1912; Reichensperger, 1912]. In reality Rio de Janeiro, collected by the United States Exploring Expedition under Commander Charles Wilkes, U. S. Navy, in 1838; see under *Tropiometra carinata*, p. 319.

?Fiji; ?Kingsmill Islands [Hartlaub, 1912; A. H. Clark, 1914]. In reality Rio de Janeiro; part of the same lot as the preceding; see under *Tropiometra carinata*, p. 318.

South Pacific Ocean; United States Exploring Expedition [A. H. Clark, 1909, 1911] (2, U. S. N. M., 2706, 2707). In reality Rio de Janeiro; part of the same lot as the two preceding; see under *Tropiometra carinata*, p. 319.

Pacific Ocean (1, M. C. Z., 75). In reality Rio de Janeiro; part of the same lot the three preceding; see under *Tropiometra carinata*, p. 319.

South Sea Islands [A. H. Clark, 1911]. This refers to the four lots of specimens given immediately above from Rio de Janeiro; see under *Tropiometra carinata*, p. 319.

Marshall Islands [A. H. Clark, 1911]. This is an error for Kingsmill (or Gilbert) Islands, and refers to the specimens listed as from that locality (in reality from Rio de Janeiro) listed above: see under *Tropiometra carinata*, p. 319.

Queensland [A. H. Clark, 1911]. This refers to the specimens labeled South Pacific Ocean and Pacific Ocean. These were brought back by the United States Exploring Expedition under Commander Charles Wilkes. With them was a specimen of *Tropiometra afra* (U. S. N. M., 4015) presumably from Queensland, and because of this they were assumed to be from the same locality. They came, however, from Rio de Janeiro; see under *Tropiometra carinata*, p. 319.

?Australia [A. H. Clark, 1911]. This refers to the specimens just mentioned.

Dr. Sixten Bock's Expedition to Japan; station 45; Bonin Islands; east of Chichijima; 164 meters; July 31, 1914 [Gislén, 1922, 1924]. This is a young example of *Tropiometra macrodiscus;* see p. 277.

Norfolk Island [P. H. Carpenter, 1888; A. H. Clark, 1911, 1912]. Dr. Maximilian Holly, who has charge of the invertebrate collections in the Naturhistorisches Museum in Vienna, has been so very kind as to write me that there is no *Antedon marmorata* in the collections under his care—indeed there are no specimens of any sort from Norfolk Island. He says that either Carpenter's record was a mistake, or the specimen has been lost.

Geographical range.—From the northeastern coast of Ceylon and the adjacent portion of India north to Waltair, about three miles north of Vizagapatam; ?Java.

Bathymetrical range.—From the low tide mark down to 9 meters.

History.—In a paper on the comatulids of the Leyden Museum published in 1881 Dr. P. H. Carpenter said that this museum contains a small and mutilated specimen of *Antedon carinata* from the Indian Ocean which differs from specimens obtained at Mauritius in the somewhat larger relative size of the lower pinnules, and in the greater smoothness of the outer portions of the arms. In a paper on the comatulids of the Hamburg Museum published in 1882 he recorded and gave notes upon four specimens from Java, comparing them with typical *carinata* from Mauritius. In the *Challenger* report upon the stalked crinoids published in 1884 Carpenter mentioned the occurrence of *Antedon carinata* in Java. In the *Challenger* report upon the comatulids published in 1888 Carpenter included Java among the localities for *Antedon carinata,* but with a query, and said he had a strong suspicion that an individual from Norfolk Island which he saw in Vienna in 1880 with the museum name *Antedon marmorata* is very closely allied to, if not identical with, *Antedon carinata;* but he said he would prefer to leave the point undecided for the present until he could make a more detailed examination of the Vienna specimen (see above). He said that he must confess to a certain amount of doubt respecting the presence of *Antedon carinata* at Java, as the Hamburg label records, and can only wait with interest for further information on the subject.

In 1888 Prof. F. Jeffrey Bell included *Antedon carinata* in a list of the crinoids of the Sea of Bengal, "taking as southern boundaries Ceylon on the west and the Nicobars on the east."

In my first revision of the old genus *Antedon* published in 1907, I included this form in *Tropiometra carinata,* but in 1908 I referred to it as *Tropiometra* sp., saying that it is known only from the Indo-Pacific-Japanese faunal area. In a paper on the crinoids of the Copenhagen Museum published in 1909, I said that a specimen of *Tropiometra carinata* from somewhere in the East Indies has the brachial carination but slightly marked and agrees well with specimens at hand from the "South Pacific" (in reality Rio de Janeiro; see p. 319) taken by the United States Exploring Expedition. This specimen, and also two others which have no data in regard to locality, are peculiar in being white. At the same time I identified a specimen bearing Lütken's manuscript name *Antedon encrinus* as *Tropiometra carinata.* In a paper on the crinoids of the Leyden Museum published in 1911, I gave notes upon a specimen from the Indian Ocean which I identified as *Tropiometra* sp., saying that it appeared to belong to an undescribed species that occurs westward from the Indian Ocean to the South Sea Islands. I said that I had not yet been able to examine a sufficient number of specimens of the animal to justify me in bestowing upon it a new specific name and added that East Indian specimens of species of this genus appear to be very rare.

In my memoir on the crinoids of the coasts of Africa published in 1911, under *Tropiometra encrinus*, new species, I gave a synonymy including *Comatula* sp., Audouin, 1817; *Alecto encrinus* Lütken, MS.; *?Antedon*, sp., Mosely, 1877, and MacMunn, 1890; *Antedon marmorata* P. H. Carpenter, 1888; and *Antedon carinata* (part) P. H. Carpenter, 1888. The localities I gave as the "Red Sea," Aden, and ?Suez. I said that this species ranges eastward to the South Sea Islands and the east coast of Asia; it appears to be generally rare, though common about Ceylon (=*indica*). Under the heading Remarks I said I was not absolutely certain that the Red Sea specimens of *Tropiometra* should be referred to this species, as I had never been able to examine any of large size, but they seem to be nearer *encrinus* of corresponding size than to any other form. I added that *Tropiometra encrinus*, while having the same number of cirrus segments as *T. carinata* and *T. picta*, has proportionately longer and stouter cirri, the stoutness being especially noticeable distally. Owing to the increased size of the cirri as a whole, the proportions of the segments are the same as in *T. picta*. There is no further mention of the characters of the new species.

In my memoir on the Recent crinoids of Australia published in 1911 I said that nothing whatever is known of the Australian range of *Tropiometra encrinus*. I included it in the key to the Australian species of *Tropiometra* with the habitat Queensland (see p. 286). Under the heading *Tropiometra encrinus* I gave a reference to my paper on African crinoids and followed this with the locality East Indies, a locality not mentioned in that paper. This was the locality of the specimen in the Copenhagen Museum with which the name *Antedon encrinus* was found, and which I reregarded as the type specimen. I said that this species is a smaller form than the preceding (*T. afra*), the arms being rarely more than 120 mm. in length; each brachial after those just at the base of the arms bears a pronounced median tubercle or keel in its distal portion; the cirri have 20–25 segments; the color is mottled yellow and purple. I remarked that there are no definite Australian records, but that I had examined a number of specimens labeled "South Pacific" which possibly came from there. The species occurs at Norfolk Island and apparently in the Marshall group. The locality Marshall Islands is an error for Kingsmill (or Gilbert) Islands. The specimens said to be from the Gilbert Islands and the "South Pacific" are really from Rio de Janeiro, Brazil, and represent *T. picta*. Nothing is known of the specimen said to be from Norfolk Island. No species of *Tropiometra* is known from that region. In my report on the crinoids collected by the Hamburg Southwest Australian Expedition published in 1911 I included *Tropiometra encrinus* among the East Indian species occurring on the coast of Australia, without giving any definite localities.

Dr. Clemens Hartlaub in his memoir on the comatulids of the *Blake* collection published in 1912 listed Java (?) among the localities from which *Antedon carinata* is known. This refers to the four specimens in the Hamburg Museum recorded by Carpenter in 1882. The localities Chile, Fiji (?), and Kingsmill Islands (?) given by Hartlaub are based on data from mislabeled specimens of *T. picta* from Rio de Janeiro.

In a paper on the crinoids of the Hamburg Museum published in 1912, I said under *Tropiometra ?encrinus* that unfortunately I had overlooked the four specimens from

Java when examining the collections of that institution. I remarked that these probably belong to *T. encrinus*, though there is a possibility that they may be referable to *T. indica*. At any rate they cannot belong either to *T. picta* or to *T. carinata*, or to the larger forms of the *T. afra* group. In a paper on the crinoids of the Berlin Museum published in 1912 I said that *Tropiometra encrinus*, as given in my memoir on African crinoids, is a composite including *T. encrinus*, *T. audouini*, new species, and *T. indica*, new species. Under the heading *Tropiometra encrinus* I listed a specimen from eastern Asia which I said was the type of the species, and one from the Indian Ocean, giving notes on both. I also gave notes on a specimen labeled "?India" in the collection of the Indian Museum. I said (under *T. audouini*) that *T. encrinus* has much larger cirri than either *T. audouini* or *T. indica*, the cirri resembling those of the American *T. picta* in having comparatively long instead of short segments in the distal portion.

In a paper on a small collection of crinoids from the Indian Ocean published in 1912 I recorded a specimen of *Tropiometra encrinus* from Sadras—an error for Madras. In my memoir on the crinoids of the Indian Ocean published in 1912, under *Tropiometra encrinus*, I gave a synonymy including *?Alecto carinata* Leach, 1815; *Comatula*, sp., Audouin, 1817; *?Antedon*, sp., Moseley, 1877, and MacMunn, 1890; *Alecto encrinus* Lutken, MS.; *Antedon adeonae* Bell, 1887; *Antedon marmorata* P. H. Carpenter, 1888; *Tropiometra carinata* (part) A. H. Clark, 1907; and 1909; and *Tropiometra encrinus* A. H. Clark, 1911. I recorded as *encrinus* 17 specimens from Galle, Ceylon (=*indica*); 2 from Sadras (that is, Madras; =*clarki*); and 5 from ?India (=*clarki*). Other records for *T. encrinus* listed were: East Indies; Muscat; Indian Ocean; east coat of Asia; Java; Aden; Tor, Red Sea; Red Sea; Tuticorin, Madras Presidency; Ceylon; Norfolk Island; and ?Suez. Only specimens from the first five localities are *clarki;* those from the Red Sea are *audouini*, and those from Ceylon and Tuticorin are *indica*. A typical specimen from eastern Asia (the one in the Berlin Museum) was figured in lateral view. In 1913 I listed *Tropiometra encrinus* as an East Indian species occurring in eastern Asia, and in my paper on the crinoids of west Africa published in 1914 I said that *T. encrinus* is known from ?India, East Indies, and Eastern Asia, and an undetermined species has also been recorded from ?Fiji, and from the ?Kingsmill (=Gilbert) Islands. In 1915 I listed *Tropiometra encrinus* as a Malayan species occurring along the coasts of China and Japan, assuming that the specimen labeled Eastern Asia was, like numerous other specimens of various species I had examined with this label, from this region.

Dr. Hubert Lyman Clark in 1915 recorded two characteristic specimens of *Tropiometra encrinus* from Ceylon and included this species, together with *T. indica*, in a list of the comatulids of that island.

In the key to the species of the genus *Tropiometra* published in his report upon the unstalked crinoids of the *Siboga* expedition in 1918 I included *encrinus*, giving as the range the eastern coast of India and eastward to East Asia. In 1932 I gave a detailed synonymy of *Tropiometra encrinus* and a detailed description of five specimens from near Mandapam, with notes on specimens from Pamban Beach, Madras, and Waltair, and figures. I gave the localities from which *T. encrinus* is known as: Eastern coast of India from Waltair south to Pamban Beach (Waltair; Madras; Mandapam; Pamban Beach); Ceylon; Java; Norfolk Island; Fiji; Gilbert (Kingsmill) Islands; Marshall Islands; and the Bonin Islands. Also recorded without precise locality from the Bay of Bengal, Indian Ocean, East Indies, ?India, eastern Asia, South Sea Islands, and South Pacific Ocean. I said that, except for those described in this paper, *T. encrinus* is known from only a very few specimens from widely scattered localities which have not been compared directly, though from what can be learned about them they seem all to be referable to the same form.

In a paper on a collection of crinoids from St. Helena published in 1933 Dr. Torsten Gislén went most carefully into the question of the status of the small forms in the genus *Tropiometra.* He had before him the specimens from the Copenhagen Museum previously studied and determined as *encrinus* by the author. He came to the conclusion that *encrinus* is a valid form distinct from *carinata,* of which he regarded *picta* as a synonym. In a paper on crinoids of South Africa published in 1938 Professor Gislén wrote:

> A. H. Clark in a letter to me (June 29th 1937) says that his earlier references to *Tr. encrinus.* are very much mixed up. In the original description of this species (Proc. U. S. Nat. Mus. Vol. 40, p. 36) the number of cirrus-segments was taken from specimens of *indica* from Ceylon which at that time he did not distinguish from *encrinus.* The specimens from Ceylon described in Crin. Indian Ocean in 1912 are *indica,* not *encrinus.* At the time of the Siboga Report Mr. Clark says that he had not seen any of the large specimens from India which he later determined as *encrinus.*
>
> The type-specimen of *encrinus* from "Eastern Asia", in the Berlin Musem, No. 5336 (cf. also Proc. U. S. Nat. Mus. Vol. 43, p. 402), is according to Mr. Clark probably identical with *Tr. carinata.* On the other hand, under the name of *Tr. encrinus,* specimens are described and figured in 1932 (Rec. Ind. Museum Vol. 34, p. 561 ff., Pls. 19, 20) which seem to be almost identical with my specimen described above [from False Bay, 17 fathoms=*carinata*]. The only difference of any importance is that in my specimen there is a well-developed dorsal spine on the Brr of the middle arm-part.
>
> Mr. Clark says that the confusion in regard to *Tr. encrinus* is most unfortunate, but he recommends giving a new name to the specimen from Mandapam described in detail on p. 561 (op. cit. 1932), which should then be the type. I do this, as it gives me the pleasure of dedicating the species to my old friend Mr. A. H. Clark.
>
> The long and many-jointed cirri, together with the stout arm-bases and tolerably short arms easily distinguish this species from those which are described earlier.

The facts insofar as they concern the application of the name *encrinus* are as follows:

In a list of Lütken's manuscript names which I published in 1909, *Antedon encrinus* is included and identified as *Tropiometra carinata* (Lamarck). Later in the same paper I included *Alecto encrinus* in the synonymy of *Tropiometra carinata* without comment. In 1911, under "*Tropiometra encrinus,* new species," I listed some features of the cirri (see page 288) with no reference to the specimen from which they were taken. In 1912 a specimen in the Berlin Museum (No. 5336) from "Eastern Asia," of which the characteristic cirri were briefly described, was said to be the type of the species (see page 289). The Berlin specimen cannot be the type of the species, for all previous references to the name *encrinus* were based upon a white specimen from the "East Indies" in the Copenhagen Museum with which Lütken's manuscript name *Alecto encrinus* was found, and which was recorded under the name of *Tropiometra carinata* in 1909 with the remark that it has the brachial carination but slightly marked. So far as the published information is concerned the name *encrinus* rests upon published notes so very vague as to be useless for diagnostic purposes, and there is no indication of the locality from which the type specimen came, or indeed of any type specimen at all. The specimen designated as the type specimen in 1912 is not the one from which the previously published notes were taken. The name *encrinus* is therefore of such dubious application and validity that a new name seemed desirable.

TROPIOMETRA CARINATA CARINATA (Lamarck)

PLATE 35, FIGURES 183, 184; PLATE 36, FIGURES 187, 188

[See also vol. 1, pt. 1, fig. 15 (disk), p. 67; figs. 264, 266 (ventral view of centrodorsal), p. 257; figs. 303, 304 (radial pentagon), p. 264; fig. 356 (cirrus), p. 293; figs. 417 (basal ray), 423 (ventral view of radial pentagon), p. 321; figs. 479, 480 (dorsal view of radial pentagon), p. 363; pt. 2, figs. 62, 63 (radial pentagon), p. 33; fig. 173 (distal arm division), p. 89; fig. 291 (arm tip), p. 221; figs. 502, 503 (pinnule tip), p. 276; figs. 729–733 (disk), p. 346; pl. 2, figs. 971, 972 (radial pentagon); pl. 23, fig. 1143 (young individual).]

?*Alecto carinata* Leach, Zool. Misc., vol. 2, 1815, p. 63 (description; no locality).—Lamouroux, Encyclopédie méthodique, vol. 2, 1824, p. 205 (after Lamarck).—[Leach], Catalogue of the contents of the Museum of the Royal College of Surgeons of London, pt. 4, fasc. 1, 1830, p. 14, No. 87.—Leuckart, Zeitschr. organ. Physik, vol. 3, 1833, p. 385, footnote (after Leach).—J. Müller, Arch. Naturg., 1841, vol. 1, p. 142; L'Institut, Oct. 21, 1841, p. 357; Abh. preuss. Akad. Wiss., 1841, 1843, p. 220 (redescribed); Arch. Naturg., 1843, vol. 1, p. 135 (redescribed).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, pt. 1, 1879, p. 4 (seems to be the same as de Fréminville's *Antedon gorgonia*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 450, 473 (status of the name); vol. 40, 1911, p. 1 (thought by Lamarck possibly to be the same as his *Comatula carinata*); Crinoids of the Indian Ocean, 1912, p. 2 (history; supposed to be the *Comatula carinata* of Lamarck; possibly from India).

Comatula carinata Lamarck, Histoire naturelle des animaux sans vertèbres, vol. 2, 1816, p. 535 (description; Mauritius).—de Blainville, Dict. Sci. Nat., vol. 10, 1818, p. 108 (from Lamarck).—J. E. Gray, Ann. Philos., new ser., vol. 12 (28), 1826, p. 393 (mouth and anus).—Eichwald, Zoologia specialis, 1829, p. 226.—de Blainville, Dict. Sci. nat., vol. 60, 1830, p. 229 (from Lamarck); Manuel d'actinologie, 1834, 1836, p. 249 (same).—Dujardin, *in* Deshayes and Milne-Edwards, Lamarck, Histoire naturelle des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 471.—Deshayes and Milne-Edwards, Histoire naturelle des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 210 (from Lamarck).—J. Müller, Monatsb. preuss. Akad. Wiss., 1840, p. 93 (intersyzygial interval); Arch. Naturg., 1840, vol. 1, p. 311 (same); J. Müller, L'Institut, Nov. 19, 1840, p. 394 (same).—Michelin, Rev. et Mag. Zool., 1845, p. 27 (Mauritius).—Dujardin and Hupé, Histoire naturelle des zoophytes, Echinodèrmes, 1862, p. 200 (synonymy; description; Mauritius).—von Martens, Von der Decken's Reise in Ost-Africa, vol. 3, 1869, p. 129 (Mascarene Islands).—P. H. Carpenter, Nature, vol. 15, 1877, p. 197 (considered synonymous with *Antedon gorgonia*).—Pourtalès, Bull. Mus. Comp. Zool., vol. 5, No. 9, 1878, p. 214 (coast of Brazil; Mauritius; Zanzibar; discussion and comparisons).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 5 (location of mouth; =*Antedon gorgonia*?); Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 157 (includes *brasiliensis* Lütken).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 464 (varies very little in east Africa), p. 473 (can not be identical with *Antedon gorgonia*); vol. 40, 1911, p. 1 (discovered at Mauritius), p. 2 (identity of Guérin-Méneville's figures; one possibly represents this species, though it looks more like some species of *Antedon;* the other [2*a*] may have been drawn from a specimen of *Amphimetra discoidea* in the P. M.); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 244 (identity); Crinoids of the Indian Ocean, 1912, p. 2 (possibly *Alecto carinata* Leach), p. 30 (identity).

Comatula (*Alecto*) *carinata* J. Müller, Abh. preuss. Akad. Wiss., 1847, 1849, p. 252 (redescription).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity); Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Comatula picta Gay, Historia física y política de Chile, vol. 8, 1854, p. 429 (description; Chile).—Dujardin and Hupé, Histoire naturelle des zoophytes, Echinodèrmes, 1862, p. 208 (name found with specimens in the P. M.).—A. H. Clark, Bull. Mus. Hist. Nat., Paris, No. 4, 1911, p. 244 (history), p. 245 (=*Tropiometra picta* [*carinata*]; Gay's types discussed).

Comatula bicolor Dujardin and Hupé, Histoire naturelle des zoophytes, Echinodèrmes, 1862, p. 208 (*nomen nudum;* a name found with undetermined comatulids in the P. M.).—A. H. Clark, Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 255 (Seychelles; identified).

Antedon braziliensis (Lütken, MS.) Verrill, Trans. Connecticut Acad. Sci., vol. 1, No. 2, 1867, p. 341 (Rio de Janeiro; *nomen nudum*); No. 4, 1868, p. 365 (very different from the specimen collected by Hart at the Abrolhos reefs).—Rathbun, Trans. Connecticut Acad. Sci., vol. 5, 1879, p. 156 (Rio de Janeiro; apparently *A. carinatus*).—P. H. Carpenter, Notes Leyden Mus., vol. 3, 1881, p. 180 (in synonymy of *carinata*); *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 199 (in synonymy of *carinata*), p. 201 (discussion).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 36 (perfectly good species; synonym of *picta* Gay; differential characters).

Antedon dubenii Verrill, Trans. Connecticut Acad. Sci., vol. 1, No. 4, 1868, p. 365 (Abrolhos Islands).—Rathbun, Trans. Connecticut Acad. Sci., vol. 5, 1879, p. 156 (Verrill's species identified as *carinatus*).

Comatula solaris von Martens, Von der Decken's Reise in Ost-Africa, vol. 3, 1869, p. 125 (Zanzibar).

Antedon ?carinatus Rathbun, Trans. Connecticut Acad. Sci., vol. 5, 1879, p. 156 (localities; range; habits in life; comparisons).

Antedon carinata P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (listed as an *Antedon*).—P. H. Carpenter, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 157 (Madagascar; Seychelles; Zanzibar; Mauritius; includes *brasiliensis* Lütken, MS.; coast of Brazil; Rio de Janeiro to Pernambuco; Bahia; Chile; St. Helena; off St. Lucia, 278 fathoms; discussion); Notes Leyden Mus., vol. 3, 1881, p. 179 (Mauritius).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed), p. 534 (specific formula).—P. H. Carpenter, Journ. Linn. Soc. (Zool), vol. 16, 1882, p. 502 (Mauritius); Proc. Zool. Soc. London, 1882, 1883, p. 746 (corrected specific formula).—Ludwig, Mém. Acad. Sci. Bruxelles, vol. 44, 1882, p. 5 (coast of Brazil; common).—P. H. Carpenter, Quart. Journ. Micr. Sci., vol. 23, 1883, p. 613 and following (relations of the vascular system).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 168 (range compared with that of *Actinometra* [*Comanthus*] *parvicirra*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, part 32, 1884, pp. 98, 109, 124, 130, 137, 235; pl. 60, fig. 2 (anatomy).—von Graff, *Challenger* Reports, Zoology, vol. 10, part 27, 1884, pp. 14, 17, 35 (Bahia; myzostomes).—Filhol, La vie au fond des mers, 1885, p. 213 (from Carpenter).—Perrier, Nouv. Arch. Mus. Hist. Nat., Paris, ser. 2, vol. 9, 1886, p. 152 (anatomy; from Carpenter).—Perrier, Mémoire sur l'organisation et le developpement de la comatule de la Meditérranée, 1886, p. 104 (same).—P. H. Carpenter, Quart. Journ. Micr. Sci., vol. 27, 1887, pp. 386, 387 (sacculi very thick at the sides of the pinnule ambulacra; the *Challenger* obtained over 100 at Bahia); *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 199 (detailed description and discussion; Bahia, 7–20 fathoms; off St. Lucia, 278 fathoms; Venezuela; Pernambuco; Abrolhos Islands; Rio de Janeiro; Chile; St. Helena; Seychelles; Zanzibar; Mauritius; Madagascar; the description and all the figures are based upon specimens from Bahia); pl. 3, figs. 1–3; pl. 34, figs. 1–7.—Braun, Centralbl. Bakteriol. und Parasitenk., vol. 3, 1888, p. 185 (myzostomes; after von Graff).—Hamann, Jenaische Zeitschr., vol. 23 (new ser., vol. 16), 1889, pp. 234, 311 and following (anatomy).—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 24, 1891, p. 68 (*Antedon rosacea* [*bifida*] is even more variable than this species), p. 68, footnote (occurs on both sides of the Atlantic).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 14 (exceptionally wide distribution), p. 113 (in Göttingen Mus.).—de Loriol, Mém. Soc. Phys. et Hist. Nat. de Genève, vol. 32, pt. 1, No. 3, 1893, pp. 4, 57 (Mauritius; a specimen from Rio de Janeiro shows no differences from those from Mauritius), p. 59 (localities from which known).—Ludwig, Abh. Senck. naturf. Ges., vol. 21, No. 4, 1899, p. 539 (Zanzibar; Madagascar; Seychelles; previous records).—D'Arcy Thompson, Proc. Roy. Soc. Edinburgh, vol. 22, 1900, p. 322 (range and its bearing on bipolarity).—Springer, Mem. Mus. Comp. Zool., vol. 25, No. 1, 1901, p. 88 (occurs on both sides of the Atlantic; range).—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, No. 1, p. 178 (color), p. 192 (partial regeneration of the cirri), pl. 7, fig. 4.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1579 (listed), pl. 4, fig. 7 (ganglion cell; from Hamann, 1889), pl. 5, fig. 5 (sense papilla from a tentacle; from Hamann, 1889).—Bell, Trans. Linn. Soc. (Zool.), ser. 2, vol. 13, 1909, p. 20 (Cargados Carajos, 30 fathoms; Farquhar Atoll, north reef; Seychelles, 15 fathoms [the record from Saya de Malha can not refer to this species, but is probably *Cosmiometra gardineri*]).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity of specimens in the Berl. Mus.).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (listed), p. 298 (distribution compared with that of *Antedon angusticalyx*), pp. 371–376 (synonymy; Zanzibar; Mauritius; Madagascar; Seychelles; off the Abrolhos Is., 30 fathoms, *Hassler*, January 20, 1872; off St. Lucia, *Investigator;* ?Fiji; ?Kingsmill [Gilbert] Islands; also Venezuela, Pernambuco, Rio de Janeiro, Abrolhos Is., Bahia, Chile, and St. Helena; detailed discussion), p. 376 (6-rayed specimens), pl. 13, figs. 5, 8.—Reichensperger, Zeitschr. wiss. Zool., vol. 101, No. 1/2, 1912, p. 59 (regeneration of the cirri; discussion of Minckert).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888= *T. carinata*+ *T. encrinus*+ *T. picta*), p. 38 (of Bell, 1894=*Oligometra serripinna*), p. 40 (of Chadwick, 1904= *T. encrinus* [*audouini*]), p. 41 (of Bell. 1909=*?Cosmiometra gardineri*), p. 161 (Brit. Mus., MS=*Decametra arabica*); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 81 (of P. H. Carpenter= *T. carinata*+ *T. indica*+ *T. picta;* of Bell, 1894= *Oligometra serripinna;* Brit. Mus., MS.=*Decametra arabica*+ *T. picta*).

Antedon bicolor P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, pt. 1, 1879, p. 29 (*nomen nudum*).

Antedon brasiliensis P. H. Carpenter. Proc. Roy. Soc., vol. 28, 1879, p. 386; Quart. Journ. Geol. Soc., 1880, p. 41 (character of the centrodorsal), p. 42 (articular faces of the radials), p. 54 (centrodorsal compared with that of *Antedon prisca*); Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 157 (synonym of *carinata*); *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 199 (in synonymy of *carinata*).—von Jhering, Rev. Mus. Paulista, vol. 2, 1897, p. 156, 2d line (Ilha de S. Sebastião).—A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 117 (synonym of *carinata*).

Antedon carinatus Rathbun, Trans. Connecticut Acad. Sci., vol. 5, 1879, p. 156 (Zanzibar; Mauritius; detailed comparison with specimens from Brazil).

Antedon sp. Lütken, Dyreriget, 1882, fig. 607, p. 616, 617.—J. E. V. Boas, Lehrb. Zool., 1890, fig. 69, p. 136.

Actinometra solaris Ludwig, Abh. Senck. naturf. Ges., vol. 21, No. 4, 1899, p. 539 (Zanzibar; from von Martens, 1869).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 403 (name found with a specimen from Madagascar in the Berl. Mus.).

Actinometra carinata Springer, Mem. Mus. Comp. Zool., vol. 25, No. 1, 1901, p. 51 (comparison with *Uintacrinus;* editorial error).

Antedon capensis Bell, Marine investigations in South Africa, vol. 4, 1905, p. 139 (description; localities), pl. 2, figs. 1–3.—A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349, footnote 2 (identical with specimens of *carinata* from Zanzibar); Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 437, 464 (same); vol. 40, 1911, p. 5 (same); Crinoids of the Indian Ocean, 1912, p. 40 (same); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 81 (of Bell, 1905=*T. carinata*+ *Comanthus wahlbergii*).

Antedon dubeni P. H. Carpenter, Quart. Journ. Micr. Sci., vol. 27, 1887, p. 386 (sacculi).

Antedon sp. P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 27, last line (6-rayed specimen).—Bather, Quart. Journ. Geol. Soc., vol. 45, 1889, p. 169 (6-rayed specimen; from Carpenter).—Bateson, Materials for the study of variation, 1894, p. 437 (same).—A. H. Clark, Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 244 (identification of this specimen).

Antedon dübeni P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 181 (the *Challenger* specimen from Bahia, but not Böhlsche's type), pl. 37, fig. 1 (but not figs. 2, 3, which represent the type specimen of *dübenii*).— A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (identity of the preceding).

Tropiometra braziliensis A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (listed).

Tropiometra carinata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (listed); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 244 (6-rayed individuals from Rio), pl. 2, figs. 1–5 (6-rayed specimens); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (*Antedon dübeni* really the young of this species), p. 152, footnote (variability in Brazil); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 217 (multiradiate individuals in their relationship to *Decametrocrinus*), p. 268 (6-rayed specimens have 6-rayed basal stars and rosettes), p. 315 (regeneration of the cirri as in *T. afra*); Amer. Nat., vol. 42, No. 500, 1908, p. 541, footnote (appears to have recently extended its range into the Atlantic); Geogr. Journ., vol. 32, No. 6, 1908, p. 607 (color); Vid. Medd. Naturhist. Foren. København, 1909, p. 182 (synonymy; includes *braziliensis*, *encrinus*, and *capensis*), p. 183 (Zanzibar [specimens from the East Indies are *clarki*]; descriptions of specimens; discussion of 6-rayed specimens; distribution); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 3 (discussion by Pourtalès in 1878, and comparison with *T. picta;* recorded by de Loriol from Mauritius), p. 5 (=*Antedon capensis* Bell), p. 8 (occurs on the southeastern coast of Africa), p. 34 (synonymy; localities); Notes Leyden Mus., vol. 33, 1911, p. 189 (compared with *Tropiometra* sp. [=*clarki*] from the Indian Ocean); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 244 (identity), p. 255 (Mauritius; Zanzibar; Seychelles, labeled *Comatula bicolor*): Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 29 (Mauritius); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 382 (specimens from Fouquet reef, Mauritius, in the U. S. N. M.), p. 384 (=*Comatula* [*Alecto*] *carinata* J. Müller, 1849; =*Antedon carinata* P. H. Carpenter, 1888), p. 403 (Madagascar; Mauritius; Fouquet reef, Mauritius; Zanzibar; detailed description of specimens); Crinoids of the Indian Ocean, 1912, p. 30 (=*Comatula carinata* Lamarck; =*Comatula* [*Alecto*] *carinata* J. Müller), p. 33 (=*Antedon carinata* P. H. Carpenter, 1888), p. 40 (=*Antedon capensis* Bell), p. 176 (synonymy; summary of previous records); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 39 (published references to specimens in the B. M.; Mauritius; Zanzibar; Cape of Good Hope; Investigations in South Africa stations 96, 97, 98, 155, 160, 165, 11801, 15610, 15597/8); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (occurs at Madagascar and adjacent territory), p. 313 (range; South Africa north to Zanzibar, also about Madagascar and among the islands of the southwestern Indian Ocean); Die Crinoïden der Antarktis, 1915, p. 104 (collected by the *Gauss* at Simons Bay), p. 163 (represents the Tropiometridae in South Africa; range), p. 166 (synonymy; Simons Bay; description of the specimens), pl. 9, figs. 4, 5.—H. L. Clark, Carnegie Inst. Washington Year Book No. 15 (for 1916), 1916, p. 192 (common at Buccoo Bay, Tobago; reactions to temperature and salinity).—Mortensen, Carnegie Inst. Washington Year Book No. 15 (for 1916), 1916, pp. 193, 194 (eggs and embryos).—H. L. Clark, Carnegie Inst. Washington Publ. 251, 1917, pp. 111–119 (habits and reactions at Tobago).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 131 (in key; range).—H. L. Clark, Littoral echinoderms of the West Indies, 1919, pp. 53, 68 (Tobago; Buccoo reef and very shallow water in Buccoo Bay; common).—Mortensen, Studies in the development of crinoids, 1920, pp. 2–23 (Tobago; embryology and development), p. 2, footnote (reasons for using the name *carinata*), p. 4 (no myzostomes found at Tobago), p. 60 and following (discussion of the embryology), text figs. 1–4, pls. 1–10.—Bather, Nature, vol. 107, No. 2683, 1921, p. 132 (review of Mortensen).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 124, 1922, p. 18 (Pigeon Point, Tobago; inorganic constituents of skeleton).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 93 (comparison with *T. encrinus*).—A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, 1923, p. 39 (range).—H. L. Clark, Ann. South African Mus., vol. 13, pt. 7, No. 12, 1923, p. 233 (Mozambique, low tide; Delagoa Bay; Itongazi river, Natal; notes).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 194, 270 (food).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 646 (Durban); Rec. Indian Mus., vol. 34, pt. 4, December 1932, p. 564 (range).—H. L. Clark, Scientific survey of Porto Rico and the Virgin Islands, vol. 16, pt. 1, 1933, p. 8 (Tobago), p. 9 (in key), p. 11 (Tobago; St. Lucia; habits).—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 92 (relation to *T. audouini*), p. 101 (range), pp. 104, 105.—Mortensen, Kongel. Vid. Selsk. Skrifter, nat. math., ser. 9, vol. 7, No. 1, 1937, pp. 61, 62 (pentacrinoids compared with those of *T. audouini*).—Gislén, Kungl. Svenska Vet. Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 4 (listed), p. 16 (Portuguese East Africa; notes).—Vaney and John, Trans. Roy. Soc. Edinburgh, vol. 59, pt. 3, No. 24, 1939, p. 664 (St. Helena; notes).

Antedon dübenii A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 469 (identity of Carpenter's specimen from Bahia).—Gislén, Ark. Zool., vol. 19, No. 32, 1928, p. 6 (=*Tropiometra picta*).

Tropiometra picta A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 3 (discussion in 1878 and 1879 by Pourtalès and Rathbun, and comparison with *T. carinata*), p. 7 (west coast of Africa), p. 7, footnote (also in the West Indies), p. 12 (west coast of Africa; also east coast of South America), p. 35 (synonymy; St. Helena; history; discussion); Notes Leyden Mus., vol. 33, 1911, p. 189 (comparison with *Tropiometra* sp., from the Indian Ocean); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 245 (=*Comatula picta* Gay), p. 255 (Chile; =*braziliensis* of Lütken and Rathbun); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 460 (6-rayed specimens compared with a 7-rayed specimen of *Dichrometra tenera* (*Lamprometra palmata gyges*)); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 28 (Santos; Rio de Janeiro; off the mouth of the Amazons; Baleiro Island, off the harbor of Victoria; no locality); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 382 (specimen from Rio de Janeiro in the U. S. N. M.), p. 402 (comparison with *T. encrinus* [=*clarki*]; Sta. Catarina Island; Rio de Janeiro; detailed descriptions of specimens; 11-armed specimen from Rio; 6-rayed specimens); Crinoids of the Indian Ocean, 1912, p. 23 (littoral, except in the Lesser Antilles), p. 33 (identity); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 40 (published references to specimens in the B. M.; localities).—Reichensperger, Abh. Senck. naturf. Ges., vol. 35, No. 1, 1913, p. 106 (discussion).—A. H. Clark, Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, pp. 309, 313 (range).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 90–D, 1914, p. 34 and following (inorganic constituents of the skeleton); Prof. Paper 102, 1917, p. 20 and following (same).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 131 (in key; range); Univ. Iowa Stud. Nat. Hist., vol. 9, No. 5, 1921, p. 7 (range; littoral); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, p. 23 (food).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 124, 1922, p. 17 (inorganic constituents of the skeleton).—A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).—Gislén, Ark. Zool., vol. 19, No. 32, 1928, p. 6, No. 23 (notes; notes on the young specimen described by Carpenter as *Antedon dübenii*).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 646 (south of Pernambuco).—Vaney and John, Trans. Roy. Soc. Edinburgh, vol. 59, pt. 3, No. 24, 1939, p. 665.

Tropiometra sp. A. H. Clark, Notes Leyden Mus., vol. 33, 1911, p. 189 ("South Pacific"); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 313 (?Fiji; ?Kingsmill Islands).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 102, 1917, p. 23 (percentage of magnesium carbonate in the skeleton); Prof. Paper 124, 1922, p. 20 (same, with additional data from specimens from Tobago).—Bather, Nature, vol. 107, No. 2683, 1921, p. 133 (review of Mortensen).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 59, footnote (sluggishness; from H. L. Clark).

Tropiometra encrinus (part) A. H. Clark, Mem. Australian Mus., vol. 4, 1911, p. 735 (Queensland), p. 780 (no definite Australian records; "South Pacific" possibly Australia; Marshall Islands).

Tripiometra carinata Preston, Zool. Rec. for 1921, 1923, p. 20 Echin. (editorial error).

Tropiometra clarki (part) Gislén, Kungl. Svenska Vet.-akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 16 (False Bay; 17 fms.).

Diagnostic features.—The carination of the arms is continued to the tips and is usually well marked, sometimes greatly exaggerated, though sometimes slight; the cirri are XIII–XXXVIII (usually XIX–XXVII), 20–30 (usually 23–24), from 15 to 27 (usually 18–20) mm. long; and the arms are up to 180 mm. in length, though seldom exceeding 135 mm.

Description.—The centrodorsal is a thick disk or a short thick column, roughly circular in outline, with a moderately large flat polar area, and the sides slightly convergent. The cirrus sockets are arranged in two closely crowded alternating rows.

The cirri are XX–XXX, 20–30 (though rarely more than 25), from 15 to 20 mm. long. The cirrus segments are all remarkably uniform, all being much broader than long. The cirri are almost circular in section at the base, becoming distally slightly compressed laterally. When viewed laterally the cirri appear to increase slightly in width in the outer half, decreasing again on the terminal two or three segments. The terminal claw is considerably longer than the penultimate segment, which is small, slightly broader than long, smooth dorsally, or with a slight tubercle situated subterminally. In the varieties in which the arms are very strongly and sharply carinate there is sometimes a sharp erect opposing spine, never very large, situated subterminally, and the ends of the cirrus segments may become slightly flaring so that they become prominent dorsally, though there is no tendency to form dorsal spines.

The distal edge of the radials is even with the rim of the centrodorsal. The IBr_1 are very short and broad, four or five times as broad as long, and are in close apposition laterally. The IBr_2 (axillaries) are triangular, about twice as broad as long, and approximately three times the length of the IBr_1.

The 10 arms are from 115 to 135 mm. in length. The first brachials are almost oblong, though exteriorly slightly longer than interiorly, four times as broad as long, or even slightly broader. The second brachials are exteriorly much longer than the first, but the proximal and distal edges come almost to a point interiorly. Broad low synarthrial tubercles are present. The first syzygial pair (composed of the brachials 3+4) is about as long as the second brachial in its greater (outer) length, but is more bluntly wedge-shaped. The five to seven following brachials are discoidal or oblong, about four times as broad as long, those succeeding becoming wedge-shaped or almost triangular, very short, then wedge-shaped again, later almost oblong, gradually elongating and at the arm tips being almost as long as broad. The four or five terminal brachials are very small and short and are curved inward between the distal pinnules which reach for 2 or 3 mm. beyond them. Beginning sometimes as early as the third brachial, sometimes not until the twenty-fifth brachial, the middle of the distal edge of each brachial is raised rather suddenly into a small tubercle which gradually increases in height distally, becoming at the same time laterally compressed and carinate, and gradually dies away toward the end of the arm. This carination is very variable. In many specimens there is hardly more than a trace of it, while in others it rises to a very considerable height forming a row of small but prominent blunt teeth down the middle line of the arm, the teeth in the proximal half of the arm standing vertically, those following gradually leaning distally.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 14+15, and distally at intervals of from 3 to 9 (usually 5–7) muscular articulations.

P_1 is 10–12 mm. long, slender, becoming almost filiform distally, prismatic, with 20–25 segments which are about as long as broad except for those in the terminal portion which are elongated. P_2 is similar to P_1, of about the same length or slightly longer, somewhat stouter, and with a long, slender, fusiform gonad. P_3 to P_6 or P_7 are of the same length as P_1 and P_2 but stouter with about 20 segments of which those in the proximal half are broader than long, those in the middle are about as long as broad, and the distal are slightly longer than broad. These pinnules bear elongate fusiform gonads that reach to within seven segments of the distal ends. From P_6 or P_7 onward the gonads become progressively shorter and occupy less and less of the pinnule. At the same time the slender distal end of the pinnule becomes proportionately longer and longer, the stout basal portion shortening with the decrease in length of the gonad. After P_{15} the gonads are greatly reduced, and they disappear entirely after P_{18}. The distal pinnules are 12 mm. long with 40–50 segments of which the first two are considerably enlarged, the first being about twice as broad as long, the second trapezoidal, and the remainder about twice as long as broad. These pinnules are very slender and filiform.

The color is violet, blotched, spotted, or banded in various ways and in varying proportions with yellow or white, more rarely entirely violet or entirely yellow or white. Specimens from deep water are purple or red, marked as in the others. The color in alcohol is brown marked with yellow.

Notes.—The specimen from Simons Bay collected by the *Gauss* is a small immature example. The cirri are intermediate in character between those of mature individuals and those of *Antedon bifida.* The brachials are wedge-shaped, not quite twice as broad as the greatest length. They bear on the distal edge numerous regular fine sharp spines which are continued proximally over the dorsal surface of the brachials as fine elevations. The lateral borders of the elements of the IBr series and the first two brachials are not wholly in contact laterally, and through the laterally extended ventrolateral edges, as in the species of *Stephanometra,* show the beginnings of the condition seen in the adults. There is no trace of a median keel on the brachials. The disproportion in size between the ossicles of the IBr series and first two brachials, and the brachials following, is not as yet pronounced. The color in life was golden-yellow, orange to somewhat brownish, with regular black spots broadening outwardly on the arms and cirri. The cirri are lighter and appear whitish, and the blackish spots purple in alcohol. This individual is comparable to the young specimen figured (as *Antedon dübeni*) by Carpenter, but it is somewhat less developed. The brachials are relatively considerably longer, although the cirri are somewhat more matured.

In the specimen collected by Dr. Mortensen in False Bay, according to Gislén, the centrodorsal is discoidal, 7.5 mm. in diameter at the base with the flat dorsal pole 6 mm. in diameter. The cirri are XXI, 28–32, from 25 to 36 mm. long, and are arranged in a partially double row. All the segments are short, the proximal being three times as broad as long and the distal from twice as broad as long to half again as broad as long. The dorsal profile of the cirri is slightly serrate, but there are no dorsal spines. There are traces of a very indistinct opposing spine. The radials are visible as very narrow bands which are almost broken off in their center. The IBr$_1$ are six times as broad as long. The IBr$_2$ (axillaries) are twice as broad as long, 6.5 mm. broad, forming with the IBr$_1$ a blunt synarthrial tubercle. The 10 arms are 110+mm. long. The first brachials are twice as long exteriorly as interiorly, and are almost free interiorly. The second brachials are longer exteriorly than interiorly, exteriorly in close apposition with their neighbors on adjacent rays though not flattened against them. The following brachials are rectangular until about the tenth, then wedge-shaped and a little thickened, especially in the mediodorsal line at the distal edge. This thickening gradually develops into a blunt dorsal spine which in the middle of the arm is distinctly visible in lateral view, distally disappearing. The middle and distal brachials are short and discoidal. Dr. Gislén gives the distribution of the syzygies on two arms as follows: brachials 3+4, 7+8, 10+11, 18+19, 28+29; and 3+4, 7+8, 14+15, 23+24, 32+33. The distal intersyzygial interval is 8–13 muscular articulations. P_1 is 15.5 mm. long with 21 segments. P_2 is 13 mm. long with 20 segments. P_3 is 14 mm. long with 23 segments. P_4 is 13 mm. long with 21 segments. All the proximal pinnules are smooth, and are prismatic after the first few segments. P_1 is slender. P_2 and the pinnules following have each a long gonad. The distal pinnules are 11–12 mm. long with about 32 segments. The centrodorsal, cirri, and arm bases are purplish brown. The middle and distal portions of the arms and the pinnules are mottled white and dark purplish. Dr. Gislén recorded this specimen under the name *Tropiometra clarki*, saying that the only difference of any importance is that in this specimen there is a well-developed dorsal spine on the brachials of the middle part of the arm. As the chief differential character of *clarki* is the obsolescence of the carination on the outer half of the arm it would seem that this specimen should be referred to *carinata*, the common and very variable form in the region from which it came.

One of the specimens from Marine Investigations in South Africa station 165 has 28 cirrus segments.

The specimen from off the Itongazi river, Natal, has the arms only 20 mm. long. The colors are pale yellow and pink purple.

In the two specimens from *Pieter Faure* station 2001, according to Gislén, the cirri are XXIII, 23, 20 mm long, and. XXI, about 12 mm. long.

The specimen from Zanzibar in the Copenhagen Museum is a fine example of the species with arms about 110 mm. long. The carination of the brachials is much reduced, appearing only as a slight median rounded and somewhat elongate tubercle in the distal half of the brachials. The peculiar abrupt termination of the arms characteristic of this family is remarkably well shown. The color is a deep purple.

Hartlaub said that the specimens from Zanzibar that he examined were stout, like a specimen from the Abrolhos Islands. Four of them were uniformly colored, dark red brown of various shades, and one was light yellowish with regular narrow red brown bands on the arms and pinnules.

The specimen from Mauritius in the Berlin Museum received from M. Guérin-Méneville has the cirri XIX, 21–23 (usually 22 or 23), 15 mm. long; the carination on the arms is very greatly developed as in certain specimens from Rio de Janeiro, each carinate process bearing a tuft of small spines. The color is purple.

In the specimen from Mauritius without further data in the Berlin Museum the cirri are XXII, 23–26, 20 mm. long; the arms are about 80 mm. long. The color is white faintly blotched with light brown.

The six largest and most typical of the specimens from Fouquet reef have the following characters:

1. The cirri are XV, 20–23 (usually the latter), 20 mm. long. The dorsal pole of the centrodorsal is flat, 5 mm. in diameter. The arms are very strongly carinate. The color is plain dark purple.
2. The cirri are XXIII, 21–24 (usually 22–23), 20 mm. long. The dorsal pole of the centrodorsal is flat, 4 mm. in diameter.
3. The cirri are XXVI, 21–25 (usually 23–24), 20 mm. long. The arms are strongly carinate.
4. The cirri are XX, 22–24 (usually 23), from 15 to 20 mm. long. The arms are about 100 mm. long.
5. The cirri are XX, 23–25 (usually 23), from 15 to 20 mm. long. The dorsal pole of the centrodorsal is flat, 7 mm. in diameter.
6. The cirri are XIX, 22–23, from 15 to 20 mm. long.

In these specimens the carination of the brachials is usually prominent. The color is usually plain purple, but some specimens have narrow yellow bands in the distal portion of the arms.

Carpenter said that the brachial carination is so slight in some individuals that he has seen from Mauritius, the locality of Lamarck's original specimen, that he would most assuredly never have given them the specific name *carinata.* He noted that, as is also the case with the Red Sea form (*audouini*), the terminal portions of the arms have stiffer pinnules and a less feathery appearance than is the case with the Brazilian variety.

In the relative development of the carination along the dorsal surface of the arms Brazilian specimens exhibit an extraordinary amount of diversity. The carination is rarely so slight as in extreme specimens from Africa, and is often greatly exaggerated, the median tubercles standing up from the dorsal side of the brachials as tall spatulate processes. This condition is correlated with the development of an opposing spine and a serrate distal border on the brachials and pinnule segments which imparts to the animal a peculiar rough feeling. I have examined specimens of this variety taken with others of the usual type, and all of those from deep water off St. Lucia are of this form. It also occurs occasionally among specimens from Mauritius (see p. 298).

In Brazilian specimens not of full size P_1 is often much longer than P_2. This condition seems merely to indicate immaturity.

A small specimen collected by the *Challenger* at Bahia was described by Dr. P. H. Carpenter under the name of *Antedon dübeni* as follows:

The centrodorsal is a slightly convex pentagonal disk. The cirri are XXX–XL, 12–15; the segments are smooth, the outer stouter than those at the base, laterally compressed, and rather longer than broad. The radials are almost entirely concealed. The IBr_1 are oblong and are not united laterally. The IBr_2 (axillaries) are acutely triangular. The 10 arms are 40–45 mm. long. The first two brachials are tolerably similar in shape, oblong or subtriangular, the second being rather the longer. A few brachials after the second syzygy may be triangular, but they soon become quadrate with the sutures but little inclined so as to be somewhat squarish in outline, becoming elongated toward the arm tips. The lower and middle brachials may overlap more or less, but the distal parts of the arms are almost smooth. Syzygies occur between brachials 3+4, 9+10, and 14+15, and distally at intervals of 2–7 muscular articulations. P_1 is over 10 mm. long and is composed of 25–30 elongated segments. P_a is about half its size with 12–15 segments. P_2 and P_b are of about the same length, and the pinnules following gradually increase, becoming very long and slender distally. There is a variable amount of calcareous plating between the rays and a few scattered granules on the ventral surface of the disk, especially in the anal interradius. The disk is about 7 mm. in diameter. Sacculi are very abundant along the pinnule ambulacra. Dr. Gislén gave additional notes on this specimen which he examined at the British Museum in August, 1925. He said that the centrodorsal is flattened with the dorsal pole convex and one-third the diameter of the base. The cirri are arranged in a partially double row. The cirri are about XX, 15, 9–10 mm. long, and have a small opposing spine. The arms are about 30 mm. long. P_1 is 5.5 mm. long with 15 segments. P_2 is 4.3 mm. long with 12 segments. P_3 is 4 mm. long with 12 segments. The discrepancies between the descriptions of Carpenter and Gislén are explained by the fact that Carpenter introduced into his description a few characters taken from the type specimen of *Antedon dubenii* which he had before him at the time he wrote.

The specimens recorded by Gislén from St. Helena showed the following characters:

1. The dorsal pole of the centrodorsal is 4.5 mm. in diameter. The cirri are about XX, 20–21, 15–17 mm. long. The arm bases are stout. The arm tips are broken. The color is purple.

2. The dorsal pole of the centrodorsal is 3 mm. in diameter. The cirri are XXXVIII, 24–27, from 20–22 mm. long. The arms are 80–90 mm. long, weakly carinate. P_1 is 11 mm. long with 25 segments. The color is dark purple.

3. The dorsal pole of the centrodorsal is 6 mm. in diameter. The cirri are XXII, 21–25, from 20–22 mm. long. The arms are about 100 mm. long. The brachials in the outer part of the arms have a small eminence distally. P_1 has 13 segments. P_2 has 15 segments. P_3 is 8 mm. long with 14 segments. The color is purple blotched with yellowish.

4. The dorsal pole of the centrodorsal is 7 mm. in diameter. The cirri are XXIX, 25–27, about 20 mm. long. The arms are about 80 mm. long. The arm bases are stout. The carination of the arms is weak. P_1 has 21 segments. P_3 is about 10 mm. long with 21 segments.

5. The dorsal pole of the centrodorsal is 3 mm. in diameter. The cirri are XIII, 20–21, 14 mm. long. The arms are 40 mm. long. This is a young specimen. The color is blotched purple and yellow.

6. The dorsal pole of the centrodorsal is 6 mm. in diameter. The cirri are XLIII, 21–26, from 22 to 26 mm. long. The arms are 170–180 mm. long. P_1 is 13 mm. long with 23 segments. P_2 is 13 mm. long with 27 segments. P_3 is 13 mm. long with 24 segments. P_8 is 11 mm. long with 24 segments. All the proximal pinnules are smooth and prismatic. The color is blotched as in the preceding specimen, especially on the outer part of the arms.

7. The dorsal pole of the centrodorsal is 5 mm. in diameter. The cirri are XXXVII, 25–26, from 20 to 21 mm. long. The arms are 75 mm. long. The color is purple.

8. The dorsal pole of the centrodorsal is 3 mm. in diameter. The cirri are XXXIII, 26–28, from 18 to 25 mm. long. The arms are about 80 mm. long. The color is purple.

9. The dorsal pole of the centrodorsal is 6 mm. in diameter. The cirri are XXIV, 22–27, from 18 to 22 mm. long. The arms are rather extensively broken. The color is blotched in the outer part of the arms.

10–18. The largest has the cirri XXXI, 28–29, about 27 mm. long, and the arms 140 mm. long. In the smallest the cirri are XXIV, 21, and the arms are about 70 mm. long. The brachials have a weak median carination and a small, often yellow, eminence on the distal part of each brachial. In the smaller specimens this eminence is often lacking.

Color and size.—Dr. H. L. Clark said that the first specimens seen at Tobago appeared to be dark purple, purplish brown, reddish brown, or bright brown, but a closer examination showed that uniform coloring was very rare. Almost always a longitudinal dorsal stripe on each arm, or transverse bands of more or less width, or both, are present. The color of these markings is yellow of some shade, often dull and buffy, but not rarely quite bright. In some individuals the pinnules are also cross-banded with yellow, and the distal pinnules may be uniformly brownish yellow. The cirri are yellow-brown, at least dorsally, but are often more or less dusky or purplish on the oral surface. In nearly all individuals, however, both old and young, the terminal two or three segments, except the claw, have a dusky spot on the oral side. This marking seems to be a very constant character in specimens from Tobago. Occasionally individuals are found in which the pinnules and dorsal side of the arms are plenteously besprinkled with silvery white, giving them an exceptionally handsome appearance.

All the small individuals found by Dr. Clark were brownish yellow or bright brown, more or less marked and banded with purple, and this general coloration is not rare in adults, particularly in those found under slabs of rock on Buccoo reef and in similar shaded places. Some of these individuals were very handsome in their brilliant array of purple and gold, and it was hard to believe that they were really identical with the dull-colored individuals from the shallows of Buccoo Bay.

A natural inference from the specimens seen is that the young are uniformly yellow or brownish yellow and that the purple pigment develops as they mature, in some individuals completely obliterating the original color, but usually appearing simply as spots, blotches, and cross bands. One could scarcely avoid the impression that the development of the pigment is associated with life in the open sunlight, but there was no opportunity for securing an answer to the interesting question which suggests itself: Do the bright-colored individuals avoid the sun because they lack pigment, or do they lack pigment because they have never lived exposed to the sun?

The largest specimens measured by Dr. Clark had an arm length of nearly 100 mm., and a few specimens exceeded that, but the great majority had arms from 60 to 80 mm. long. Several very small individuals were found under rocks on Buccoo reef, but the smallest one seen, having arms about 18 mm. long, was discovered in a clump of *Corallina*.

Abnormal specimens.—Dr. P. H. Carpenter said that, except for a 6-rayed individual of *Neometra pulchella* (see Part 3, p. 137), the only 6-rayed comatulid he knew of was a small dry *Antedon* in the collection of the British Museum. In this the disk is sufficiently well preserved to show that the additional ray is inserted between the two of the right side (D and E). Suspecting that this specimen might be an example of this form I asked my friend the late Prof. F. Jeffrey Bell to be so good as to examine it for me. This he very kindly did, and he wrote me that it was, as I had surmised, a specimen of *Tropiometra carinata*, but there was no record of the locality whence it had come.

Among 260 specimens from Rio de Janeiro in the collections of the United States National Museum (6), the Museum of Comparative Zoology at Harvard College (248), and the Yale University Museum (6) that I examined in 1907 I found no less than 17 that are completely and perfectly 6-rayed (see Part 2, p. 82). None of those from any other locality that I have seen have more than 5 rays. These 6-rayed individuals are all but one of comparatively small size with an arm length of from 50 to 60 mm., the exception having an arm length of 95 mm. and being the only one sexually mature. In 12 of the 17 6-rayed specimens the disk can be examined without injury to the arms or pinnules. In three of these it is quite impossible to tell which is the extra ray, as six ambulacral grooves, all, so far as can be seen, exactly alike, converge at the mouth. An examination of the radials and postradial series furnishes no clue, as they are all quite alike. One specimen has the additional ray interpolated between the two on the left side, one has it behind the right posterior ray, and 7 have it inserted behind the left posterior ray (see Part 2, figs. 729–733, p. 346).

In a specimen in the Museum of Comparative Zoology one of the arms divides on the thirty-ninth brachial (see Part 2, fig. 173, p. 89).

A specimen from Rio de Janeiro in the Berlin Museum has 11 arms, one IIBr 2 series being present.

Dr. H. L. Clark said that at Tobago no individuals with more or fewer than ten arms were noted in more than 200 examined, but several cases of arms forked distally were seen, and in one case a forked pinnule was noted. As a rule the arms were approximately equal, but in some individuals those of one side were distinctly shorter than the others. In such cases, however, it was usually obvious that the short arms were regenerating.

Early stages.—The early stages of this species have been described by Dr. Th. Mortensen from material collected at Tobago, where it occurs in fair numbers in places on the coral reef at the western end of the island, sometimes in such shallow water that it is exposed at the lowest tide. Mortensen says that this is a very hardy species, and there was no difficulty in keeping specimens alive in jars, even for several days. Late March and April were just in the breeding season, and the first lot of specimens gave a few larvae. After this he succeeded repeatedly in getting cultures of larvae, never in great numbers, but sufficient to enable him to secure material for a fairly complete study of its development.

As the red-brown larvae are quite opaque, nothing of the interior structure and its successive transformations could be seen on the living object. Only the first cleavage stages could be studied directly; from the gastrula onward all the developmental processes, excepting the development of the skeleton, must be studied by means of sections.

The relative scarcity of the material, together with the not very good preservation and the difficulty of the orientation of the embryos in the younger stages prevented Mortensen from making a complete study of every detail in the developmental processes. Also the very rapid succession of the different stages in the development added considerably to the difficulties in securing every stage.

The egg is free, probably pelagic, and the larvae, which are very active swimmers and in the jars were generally found swimming at the surface, may keep up their pelagic existance for quite a long while.

If the larvae find a suitable place for fixation they may attach themselves when only two or three days old; otherwise they may swim for six or seven days, and Mortensen had one specimen that did not attach itself until it was eight days old. Mortensen says that as a result of this facultative prolonged swimming period the larvae may be carried for considerable distances by currents, and this accounts in a natural way for the wide distribution of the species.

In accordance with the comparatively long period of active swimming of the larvae the pentacrinoids are not found attached to the cirri or other structures of the adults. Indeed, he found no free pentacrinoids. Not knowing whether the larvae have any special preferences regarding objects to which to attach themselves Mortensen tried putting several different things into the jars with the larvae. He tried algae, especially *Udothea* and *Corallina*, coral pebbles, bivalve shells, and leaves of Zostera (*Thalassia testudinum*). Although individuals attached themselves to almost all these objects, they did not prove equally favorable. The most favorable attachments were made upon *Udothea* and *Corallina*. A good many individuals attached themselves to the surface film of the water and here they developed into very fine pentacrinoids.

The greater number of the individuals that attached themselves to the *Thalassia* leaves dropped off and fell to the bottom of the jar, but continued developing lying on the side unattached. This had, however, a curious effect on them. The vestibulary invagination did not close up and the thickened skin of the bottom of the invagination continued to be in contact with the anterior (by this time posterior) end, by which they should have been attached. This thickened skin therefore acted as a band keeping the (now) anterior end of the embryo down. As the columnals kept on growing normally the stem became more and more curved, the result being that the embryo assumed a peculiar shape resembling a pipe. Even in spite of this abnormal shape some of these specimens went on growing and at last developed into pentacrinoids differing from the normal ones only through having the head bent downward, and Mortensen said that he can scarcely doubt that it would have been possible to rear them to full development if time had permitted.

On account of the brevity of his stay at Tobago Mortensen did not succeed in getting the pentacrinoids very far in their development. On leaving the island he carried some of his cultures with him in the hope that they might stand transportation and continue their development. While staying in Port of Spain, Trinidad, waiting for the steamer for New York, he had the cultures placed in one of the laboratory buildings of the Botanical Gardens through the kind permission of the director, Dr. James B. Rorer. During these five days everything went well, though there was no opportunity for changing the water. On board the steamer it was difficult to find a suitable place for the cultures, and one night, when near New York, the temperature went down too low, so that the pentacrinoids were chilled. On his arrival at New York he had them placed in the Aquarium under excellent conditions, suitable temperature, and light. Although some of the pentacrinoids were still alive, they did not recover from the chilling and did not develop any further, so that he thought it useless to try to carry them alive to Copenhagen and preserved them.

Mortensen says that a difficulty in describing the development of a crinoid arises from the orientation, on account of the fact that the larva attaches itself by the anterior end, the posterior end of the larva becoming thus the oral end of the pentacrinoid. He remarked that Seeliger orients the pentacrinoid in the same way as the larva, head downward. Although there is a morphological reason for this, it seemed to him too unnatural. Consequently he adopted the method of Bury and represented both the larva and the pentacrinoid in their natural position.

The eggs are rather small, about 0.2 mm. in diameter, opaque, whitish with a faint reddish tint. On being discharged they are surrounded by a distinct clear follicular membrane. The peculiar structure of the follicular membrane described by Ludwig in *Antedon mediterranea* he did not observe in *Tropiometra*. It is true that he did not look especially for it in the living object, not remembering anything about the structure at that time; but the fact that he did not notice anything of the kind makes it fairly certain that no such structure of the follicular membrane exists in this species.

While in *Antedon* the eggs remain attached to the pinnules during the first stages of development, for a period of from four to six days, in *Tropiometra* they are attached for only a very short time. Almost immediately after the extrusion from the genital opening the follicular membrane dissolves and the naked eggs sink to the bottom. Fertilization does not take place until after the egg has become free.

Repeatedly he found the bottom of the jar in which the specimens were kept entirely covered with eggs discharged during the night. Eggs were never found to be discharged during daytime.

The formation of the egg membrane, according to Mortensen, is very interesting to follow. Immediately upon the entrance of the spermatozoon the egg secretes a thick layer of a slimy looking substance, not regularly limited outwardly. The inner part of this layer at once acquires a harder consistency, thus forming a membrane, the edge of which is sharply defined toward the egg surface, while outwardly it acquires its final structure only gradually. The formation of this structure starts at one place and spreads thence over the whole egg. When fully formed the membrane consists of polygonal areas, slightly sunken, with very distinct elevated ridges. Each angle bears a distinct spine. The spines are formed by the outer part of the slimy layer. Sometimes he observed a radiating striation in it. After the formation of the spines this layer is hardly discernible; still, a fine line may be seen uniting the points of the spines. The whole process occupies 15 to 20 minutes.

The fully formed membrane is a very beautiful object. It recalls the egg membrane of *Callionymus*. He suggested that its peculiar structure is a special adaptation forming a floating apparatus. Although the eggs were always found lying on the bottom in the dishes until the embryo left the membrane, it can hardly be doubted that when free in nature the slightest movement of the water must act on this spiny membrane, causing the egg to drift.

Mortensen said that the egg membrane of *Antedon* has received very little attention. Only Sir Wyville Thomson describes it, as "perfectly transparent and structureless, with the surface slightly and irregularly echinated." In *Antedon*, therefore, there is evidently nothing like the structure in *Tropiometra*.

Segmentation begins very soon after fertilization, the blastula stage being reached after about two hours. In *Antedon* this stage is not reached until 6 (Seeliger) to 12 (Bury) hours after fertilization. The first cleavages are quite regular. In the later stages there is a slight inequality, so that in the newly formed blastula the cells are somewhat larger at one pole of the embryo. This inequality, however, soon disappears completely, and Mortensen was unable to ascertain whether the invagination takes place at the pole where the larger cells occurred.

When the embryo is about two and one-half hours old the formation of the entoderm begins. It starts with the wandering into the cavity of the blastosphere of several cells. These cells lie loosely in the cavity of the blastosphere and look like mesenchyme cells which, however, they are not. It appears that they come irregularly from different parts of the blastosphere. When the cavity is nearly full of these cells the typical invagination takes place, and the loose cells now arrange themselves regularly at the upper end of the invagination. Probably, according to Mortensen, the formation of the mesoderm cells starts again from these cells, but at one time all the formerly loose cells have joined the entodermal invagination.

The formation of the entoderm thus differs considerably from that of *Antedon* in which, according to Seeliger, no such wandering of free cells into the blastocoel takes place before the invagination. However, it must be mentioned that in one case Mortensen found the invagination starting before any loose cells had wandered into the segmentation cavity. In this case the formation of the entoderm thus proceeds as in *Antedon.* Mortensen remarked that it is rather startling to find that there can be so great variation within the same species in so important a process as the formation of the entoderm.

The ectoderm cells in the oral half of the embryo have their inner ends turned upward, making a very characteristic arrangement. It looks as if they were pushed upward by the invagination. The little space left by the archenteron, together with the considerable elongation of the ectoderm cells at this stage, accounts for this peculiar feature.

In the lower end of the archenteron, near the blastopore, the cells are quite low; in the upper wider part they are high and cylindrical. The cavity of the archenteron is very narrow and makes a characteristic curve in the upper part. The blastopore is a small round opening, not an elongated slit as in *Antedon.*

The gastrula is fully formed about five hours after fertilization. In *Antedon* this stage is reached, according to Seeliger, about sixteen hours after fertilization, but according to Barrois and Bury it is not reached until twenty-four hours after fertilization, this discrepancy being evidently due to the fact that Seeliger worked on *Antedon adriatica,* while Barrois and Bury worked on *A. mediterranea.*

In some cases Mortensen found the whole space within the egg membrane filled, instead of by an embryo, with a uniform mass of minute spherules, besides a couple of deeply staining protoplasm masses, looking like a pair of cleavage cells, but containing no nuclei. This would appear to be some kind of parasitic organism. Mortensen said that it had seemed to him worth while to call attention to this, although he was unable to say more definitely what it was.

When the gastrula stage is reached the embryo begins to rotate within the egg membrane, being covered with a uniform ciliation. About six hours after fertilization the rupture of the egg membrane takes place, and the embryo swims out. Only a small opening is formed in the membrane, through which the embryo must squeeze itself out. The empty membrane may be found on the bottom of the jar undisturbed except for the hole through which the embryo crept out.

Just after its liberation the embryo is slightly pear-shaped, being a little pointed at the apical end and a little truncated at the oral end. There is thus no difficulty in seeing directly that the position of the blastopore is at the posterior end of the larva. Further, this shape of the embryo facilitates the orientation in sectioning, the longitudinal axis being always distinct from the moment the embryo is liberated, while the spherical embryo of *Antedon* cannot be oriented with certainty in sectioning until the vibratile bands have been formed, the situation of the archenteron nearer the posterior end and the more numerous mesenchyme cells in the anterior end affording the only means by which to identify the longitudinal axis.

The ciliation is still quite uniform, and there is no indication as yet of the ciliated bands. The blastopore closes immediately after the liberation. In embryos ten hours old the apical tuft of cilia is distinct, but the ciliated bands do not begin to appear until the embryo is twelve hours old.

The ectoderm, which in embryos six hours old is a typical epithelium with the nuclei arranged fairly regularly in a single series at the basal end of the cells, is considerably thickened with the nuclei arranged pluriserially. It is, however, still distinctly a single layered epithelium. At the anterior end under the apical tuft it is more or less thickened, this part corresponding to the apical pit of *Antedon*, but it is never so conspicuous as in that form. In embryos eight hours old the archenteron is nearly separated into an upper and lower part through a median constriction. The blastocoel cavity is completely filled by mesoblast cells; also at the oral end, below the archenteron, a group of mesenchyme cells has made its appearance; that these are derived from the lower end of the archenteron seems beyond doubt.

The complete separation of the archenteron into an upper part, the entero-hydrocoel (the mesentero-hydrocoel of Bury and Seeliger), and a lower part, the coelomic vesicle, may take place at an age of only ten hours, though in other cases the two parts may still be in wide connection at this age.

In embryos 12 hours old the lower part of the coelomic vesicle begins to form two lobes extending somewhat forward and connected by a narrower part. These two lobes represent the right and left coelom.

The anterior part, destined to form the intestine and the hydrocoel (the mesentero-hydrocoel of Bury and Seeliger) forms a pouch which is doubtless the rudiment of the hydrocoel. Although its constriction from the entoderm could not be followed, the comparison with what obtains in *Antedon*, as represented by Seeliger, leaves hardly any doubt that this is really the first trace of the hydrocoel. On the other hand Mortensen says he would not venture to maintain that the pouch seen in a corresponding place in an embryo only ten hours old and with the archenteron still undivided is really the same thing, though it might not seem improbable.

The entero-hydrocoel is a simple vesicle, with no posterior prolongations to embrace the narrow middle part of the coelomic vesicle. The relation between the two primary vesicles is thus quite simple, and the complicated structure that occurs in *Antedon* is seen to have no general value in the developmental history of crinoids.

Concerning the histological character of the two entodermic vesicles it need only be stated that they consist of a simple rather low epithelium, distinctly lower than the ectoderm. The formation of mesenchyme cells appears to continue until about the time when the separation of the two entodermic vesicles takes place; but already at the age of eight hours the blastocoel cavity may be completely filled by the mesenchyme cells. The nuclei of the entoderm and mesenchyme cells are generally distinctly larger than those of the ectoderm, a feature that may be observed throughout the embryonic development.

In embryos 16 hours old the ciliated bands are fully formed. There are only four of these, not five as in *Antedon adriatica* and *A. mediterranea*. Sir Wyville Thomson figured only four ciliated bands in *A. bifida*, so that it would appear that even within the same genus the number of the ciliated bands may be variable. However, Mortensen says, this certainly needs confirmation, as it seems doubtful whether so conspicuous a difference would exist between closely related species.

The second band apparently ends abruptly on the sides of the vestibulary invagination, but on closer observation it may be seen to continue along the borders within the vestibulum, around its posterior end, although in the specimen figured this could not be distinctly ascertained. The first band is pushed slightly upward, the third slightly downward, by the vestibulary invagination. The posterior ciliated band lies in a slight depression. The anterior or apical pit is not so distinctly circumscribed as in *Antedon.*

The vestibulum, which begins as a flattening of the ventral side of the embryo at the age of 12 hours, now forms a distinct invagination of broad oval outline.

The ectoderm in embryos 16 to 20 hours old is distinctly limited toward the mesenchyme, but from the age of 25 hours onward no limit can be seen. In sections stained with hematoxylin elements are seen in the ectoderm that stain very strongly and look like glandular cells. Mortensen says that although the preservation is not quite satisfactory, he has no doubt that these elements correspond to the "yellow cells" of the *Antedon* larva, which are also supposed to be of glandular nature. In the vestibulary invagination the ectoderm stains very strongly in hematoxylin, a feature which does not depend alone on the fact that the nuclei are here much more numerous than in the other parts of the ectoderm. Possibly this indicates a glandular character of the cells of the invagination. Bury mentioned the same feature in *Antedon,* but pointed out that they lose their color much more readily in acidulated alcohol than do the glandular cells of the ectoderm. Bury found these deeply staining cells only in the anterior, deeper, part of the vestibulary invagination. In the *Tropiometra* larva the cells have this character throughout the whole length of the invagination.

In a specimen 25 hours old Mortensen observed very distinctly a feature described by Seeliger in *Antedon,* that is, that the ectoderm cells secrete between themselves an intercellular substance, this process being the beginning of the transformation of the ectoderm which ultimately results in the complete intermingling of the ectoderm cells with the mesenchyme, so that in the later stages of development there is no separate ectoderm layer. The details of this process could not be followed in *Tropiometra,* but since the first stage of the process and also the end result are the same in *Tropiometra* as in *Antedon,* that is evidently no reason to doubt that the whole of the process is identical with that obtaining in *Antedon,* as described by Seeliger.

In an embryo 40 hours old a depression is visible just in front of the vestibulary invagination that evidently represents the suctorial disk by means of which the larva attaches itself. It is seen very indistinctly except in sections. The anterior ciliated band passes uninterruptedly between the disk and the invagination, as is also the case in *Antedon.*

The ciliated bands generally appear in sections as slightly concave structures; sometimes, however, they are distinctly convex, while at other times they appear to be nearly flat. The differences are evidently due to differences in preservation.

The nervous system, first seen by Bury in the *Antedon* larva and described in detail by Seeliger, appears to exist also in the *Tropiometra* larva in at least the same degree of differentiation, or probably even somewhat more strongly developed. In the anterior end, below the apical tuft, is seen a conspicuous layer of an exceedingly fine fibrillar substance which continues more or less distinctly downwards, below the vibratile bands. The nerve passing along the side of the vestibulary invagination may also be observed, but not so distinctly as appears to be the case in *Antedon.* Unfortunately the preservation is not good enough to permit the determination of its nervous character from the histological structure, but from the complete analogy of its position with the nervous system of the *Antedon* larva it would appear beyond doubt that this structure in the *Tropiometra* larva represents the nervous system.

In embryos 16 hours old the right and left coelomic vesicles have separated completely and are about to assume their final position, the left at the posterior end of the embryo, the right along the dorsal side covering the entoderm. The right vesicle widens gradually, so that at the age of forty hours it occupies the whole dorsal side in the posterior half of the embryo. The epithelium of the vesicles soon begins to flatten, and at the age of forty hours has completely assumed an endothelial character.

Mortensen says that it was not possible to follow the details of the formation of the chambered organ, but in an embryo twenty-five hours old the first rudiment of it is seen in the shape of a forward prolongation from the right coelomic vesicle. Whether there are five such prolongations, as in *Antedon,* Mortensen was unable to determine; but he remarks there would be scarcely any reason to doubt that the development of a structure so fundamental in crinoid anatomy as the chambered organ must proceed in the same way, at least in the uniform group of the comatulids.

At the age of 16 hours the hydrocoel has been completely separated from the entoderm. It sends out a forward prolongation, still in open connection with the hydrocoel vesicle. This is the future parietal canal. At the age of twenty hours it is completely separated from the hydrocoel. It is only a short vesicle. Mortensen never found it prolonged anteriorly as is the case in *Antedon,* and as he also found it in *Compsometra serrata, Isometra vivipara,* and *Notocrinus virilis.* The pore canal does not begin to develop until about the age of forty hours, and there is as yet no exterior opening.

Mortensen says that Russo maintains that the parietal canal remains in open connection with the hydrocoel. In *Tropiometra* this is decidedly not the case, and the same holds good for *Compsometra serrata, Isometra vivipara,* and *Notocrinus virilis.* As for *Antedon,* Mortensen remarked that Russo's figure to which he refers especially as a proof of his statement does not appear to him to be a very clear and convincing proof in the face of Seeliger's clear and detailed figures. Certainly the figure shows a connection between the parietal canal and the hydrocoel, but it would appear to be the stone canal which is here seen to open into the parietal canal, and that does not prove that the parietal canal was always in connection with the hydrocoel.

The hydrocoel, which at first is a simple vesicle, sometimes very wide, gradually curves and assumes the shape of a horse-shoe. The opening is at the left side. The primary tentacles have begun to appear already at the age of forty hours. There is still no trace of a stone canal to be seen at this stage.

The entoderm remains a simple sack, distinctly dorsoventrally compressed toward the end of this period. It should be emphasized only that no cells are observed to wander into its lumen.

In accordance with the fact that fixation may take place at very different ages, some larvae attaching themselves at the age of two or three days and others not until they are seven or eight days old, the processes that accompany the transformation from the free swimming larva to the young pentacrinoid may pass at very different speeds, and thus it is not possible to say at what age one or another stage in the later development occurs. It may be said only that it is the fixation that hastens the development, while up to that time the developmental processes are going on very slowly, or not at all.

Mortensen said it often happened that embryos that had attached themselves to unsuitable objects, especially the leaves of *Posidonia*, dropped off and fell to the bottom of the jar. The reason for this evidently was that diatoms and other micro-organisms growing on the *Posidonia* leaves hindered the fixation to the leaf. Doubtless the suctorial disk secretes some kind of fluid by means of which the fixation takes place, but in this case it would not act because the disk could not touch the surface of the leaf itself.

The embryos lying on the bottom did not die, neither did the developmental processes cease; but the development proceeded abnormally, resulting in the embryos assuming a peculiar pipelike shape. It is the vestibulum that is first affected by the failure of the fixation. The process of closing does not continue to the end. The fold of the epidermis which normally gradually covers up the invagination stops growing when it has reached about midway. The aboral (previously anterior) end of the invagination remains unaltered. When the vestibulum closes normally a remarkable rotation takes place, the vestibulum wandering from the ventral side to the oral (previously posterior) end of the larva, carrying with it the hydrocoel and other internal structures. While at first the vestibulum is contiguous with the disk of fixation, it now lies at the opposite end of the larva. There has thus taken place an enormous prolongation of the part of the epidermis lying between the disk of fixation and the vestibulary invagination—that is, the part occupied by the first (in *Antedon* second) vibratile band. The closure of the vestibulum is, so to speak, the sign for the commencement of this prolongation. But when the closure is not complete the prolongation of this part of the epidermis does not take place—there is no stimulus to start it—and the vestibulum continues to be contiguous with the disk. Meantime the developmental processes otherwise proceed normally, and the columnals of the young pentacrinoid especially grow rapidly. But gradually there is no room for the stalk, and it thus has nothing left but to curve in an arch, and the embryo becomes humpbacked.

In spite of the incomplete closure of the vestibulum the hydrocoel and other internal structures continue their development normally, and as Mortensen's series of normal embryos in the fixation stage was very limited, he found it necessary to use also these pipe-shaped humpbacked specimens for the study of the development in the stage of transformation from the free swimming larva to the young pentacrinoid.

The fact that these humpbacked embryos may develop into true pentacrinoids differing from the normal ones only in having the head bend downward, like a drooping flower, is of no small interest. Using the *Posidonia* leaves for the larvae to attach themselves to has thus resulted in an unintentional experiment to test the significance of that remarkable embryonic structure, the vestibulum.

Mortensen recalled that Barrois has recorded a similar unintentional experiment with the larvae of *Antedon*, the result being the same—the development of the internal organs goes on normally despite the abnormal position. Only it does not appear that Barrois has seen them develop into true pentacrinoids. Seeliger also has seen abnormal embryos developing their tentacles, although the closure of the vestibulum had not taken place—even less so than in the cases observed by Barrois and Mortensen—there being in the cases observed by Seeliger no covering up at all of the vestibulary invagination, so that the tentacles are at once free. Seeliger did not see these abnormal embryos develop into pentacrinoids. As was pointed out by Seeliger, the crinoid embryo with tentacles developed on the ventral side described and figured by Busch must have been such an abnormal embryo.

The main point, or at least the most conspicuous point, in the transformation of the embryo from free swimming to fixed is the closure of the vestibulum. This proceeds in the same way as it does in *Antedon*.

The glandular character of the cells of the vestibulum is indicated by the fact that they retain the hematoxylin as strongly as do the glandular cells of the outer ectoderm, but it disappears with the closure of the vestibulum. Also in the epidermis itself the glandular cells disappear. This is correlated with the intermixing of the ectoderm with the mesenchyme, which process has been completed by the time the larva has attached itself. Some few cells may still remain attached to the surface by means of more or less branching prolongations. That these "multipolar" cells are the remnants of the ectoderm cells can hardly be doubted, for they are not found in the pentacrinoid stage.

The suctorial disk loses its special histological character as soon as fixation has taken place. The same is the case with the larval nervous system.

The exact time when the hydrocoel ring closes has not been ascertained, but it takes place during the stage of transformation from the free swimming larva to the young pentacrinoid, and the important organs, the pore canal and the stone canal, are formed also during this period.

The pore canal was seen first in the four-day-old free-swimming embryo. It still has no exterior opening. Its appearance in the specimen as a small ring lying within a more spacious lumen must be due to some contraction during preservation.

The stone canal is quite short. In one section a thickening is seen in the left oral mesentery, an ovoid mass of cells lying in the space between the epithelium of the oral and aboral coelom and separating them from each other. Mortensen says it seems certain that this corresponds to the primary genital gland found in *Antedon* by Russo, a rudimentary organ which soon disappears, but which, according to Russo, is of great morphological importance, being homologous with the genital gland of the holothurians, while the axial organ of the crinoids is a thing apart, and not at all homologous with the ovoid gland of other echinoderms.

Russo in *Antedon* found the first traces of this gland in pentacrinoids which had already been attached for some five or six days and already had a long stalk. In *Tropiometra* it appears somewhat earlier. Mortensen was unable to see this gland in decalcified and stained pentacrinoids of *Tropiometra*, though it was easily observable in unsectioned pentacrinoids of *Compsometra serrata* and of *Isometra vivipara*.

Mortensen said that the formation of the primary tentacles needs no description.

The coelomic vesicles have assumed their final position, the left at the oral end, between the hydrocoel and the entoderm, the right at the aboral end of the entoderm, and they are now distinguished as the oral and aboral coelom. The aboral coelom has formed the vertical mesentery, and in it the axial organ has made its appearance. Also the chambered organ is assuming its final shape and is seen very distinctly continuing through the whole length of the stalk; but this was already the case previous to fixation.

The entoderm undergoes very important changes. First the rectum develops after the fixation, but it does not open externally—there is not even an invagination of the epidermis to meet it. Then the mouth opens into the vestibulum. There is an invagination of the thick ectodermal layer forming the bottom of the vestibulum which meets the entoderm and forms the esophagus.

A very conspicuous feature in the development of the intestinal tract in *Antedon* is the wandering of cells from the wall of the stomach into its lumen to be devoured there and thus to provide nourishment for the young crinoid until its mouth opens and it can procure its own food. This remarkable method of feeding itself is not seen very clearly in *Tropiometra*. In fact, Mortensen was not at all sure that it occurs in this genus. He says that in *Antedon* the object of these cells is certainly not to be devoured by the larva, as assumed by Seeliger; instead he believes Bury to be right in regarding them as phagocytes which produce an histolysis of the larval tissues, especially of the entoderm.

Some of the Mortensen's larvae attached themselves to the surface film of the water, developing into very fine pentacrinoids, and the specimens used for sectioning were from these. None of them reached so far as to open up the vestibulum, but the covering of the vestibulum is thinning out in the middle and must be very near the time of opening. The other pentacrinoids that went so far in their development did not afford sufficient material for study by means of sections, but as none of them went much farther in their development—in none of them has the formation of the arms begun—there could hardly be expected any noticeable progress in the internal development beyond the stage figured.

The ectoderm has lost the last trace of its original character, and there is henceforth no distinguishing of the former ectoderm cells from the mesenchyme cells; also, the glandular cells have completely disappeared.

The basal disk, which could be readily studied intact in these specimens from the surface film in which no force was needed to loosen the attachment, shows the interesting feature that a rather thick cuticular layer has been secreted. This probably represents the secretion by means of which the attachment is effected. A similar thick cuticula on the base of the stalk was also observed in *Antedon* by Seeliger. The upper side of the basal disk contains numerous small grains which stain strongly in hematoxylin, the cell nuclei among them appearing only very lightly colored.

In the vestibulum the thinning out of the high epithelium of the basal wall has just begun. The formation of the oral nervous system apparently has not yet begun.

The hydrocoel ring has just closed; in the anal interradius a narrowing of the lumen of the ring is still seen, across which a thin dissepiment runs. This is no trabecule, but the joined end walls of the two ends of the hydrocoel. It is still intact, so that the lumen of the ring is not yet continuous. The epithelial lining of the hydrocoel ring has assumed an endothelial character, and numerous trabeculae cross its lumen. Two pairs of tentacles have developed at the side of each primary tentacle. The outer of these pairs represents the interradial tentacles. In the sections through the vestibulum the tentacles are seen to be separated from one another by a fine but distinct line which probably indicates the presence within the vestibulum of a slimy fluid.

The communication between the hydrocoel and the exterior has at last become established. Russo wrote that in *Antedon* the original hydropore and pore canal become obliterated three to four days after the fixation of the larva; from seven to eight days after the fixation the definitive hydropore and pore canal develop. In *Tropiometra* Mortensen was unable to ascertain whether this likewise takes place, not having sufficient material of the later stages of the pentacrinoids; but in any case there has been no exterior opening before this stage.

Mortensen said it should be mentioned that in one series of longitudinal sections of an embryo ten hours old there is seen a kind of tube or canal visible through five consecutive sections. With its outer end it forces itself to some degree in between the ectoderm cells, pushing their basal ends aside. But it does not reach the surface, and there is no outer opening. One might be inclined to see in this a primary pore canal, but as far as can be judged from the somewhat unsatisfactory preservation of the interior of this embryo (the ectoderm and the tube under consideration are very well preserved) the entoderm is in a very primitive stage of development, not yet separated into its two main parts, and there is, of course, no trace of the parietal canal as yet. Furthermore, it is impossible to discover any connection between the entoderm and the inner end of the tube. It is therefore difficult to see how this could represent a pore canal. In *Antedon* Seeliger found the pore in the fully formed larva, not in a stage so young as this.

Mortensen pointed out that Russo did not distinguish between the stone canal and the pore canal, designating both as "canale petroso." He certainly distinguished the "canale petroso interno o primario" and the "canale petroso esterno o secondario," but as, according to Russo, there is also a primary external "canale petroso," the nomenclature is confusing. The distinction between the stone canal and the pore canal is of great morphological importance, as is well emphasized by Bury, and Mortensen rightly maintains that it should certainly be clearly upheld.

The pore canal opens into the parietal canal, and the stone canal opens into the latter. The parietal canal is in direct communication with the coelom. Thus the final arrangement of the interrelations between the hydrocoel and the coelom have become established. But there is still only the one (primary) stone canal and pore canal.

The oral coelom appears to be in open communication with the aboral coelom.

The stomach is empty, showing no cells in its lumen. The rectum is now well developed and about to open to the exterior. The epidermis shows a slight invagination over it, but there is still no anal opening formed. The place of the future anal opening is seen to be near the adjoining radius, not in the middle of the interradius. When it has been formed the young crinoid is ready to open the vestibulum, and the embryonic life proper is ended.

The first rudiments of the skeleton appear at the age of 24 hours, when the basals and orals may be seen lying in two half circles which are open ventrally. The plates of these two half circles do not correspond exactly to one another. There is some shifting, as is also the case in *Antedon*. It is evident that the plates do not all appear at one and the same time. Orals I and II are slightly larger, and therefore older, than the other three orals, and basal V has just appeared as a minute grain, while the other four have already begun to form small processes. The terminal stem plate has appeared, together with five columnals. It is noticeable that the columnal nearest the terminal stem plate is smaller than the next one, showing that it is not the first formed. In another larva 24 hours old the skeleton is somewhat more developed. The terminal stem plate and some of the basals and orals are distinctly branching. The columnals still number only five. Here, however, the one nearest the terminal stem plate is the largest, so that in this case it would appear to have been the first formed. Important new skeletal elements have appeared. At the upper (oral) end of the column three very small calcareous grains are seen which are the first traces of the infrabasals. Their definite number can not be stated from this young stage, but the stages following afford proof that there are only three of them.

In a larva 30 hours old the orals and basals, as well as the terminal stem plate, have enlarged considerably, and are now more or less fenestrated plates. Their relative position has changed somewhat so that they are no longer arranged in the form of a horseshoe. The vestibulum could not be made out in this specimen, but Mortensen says that judged from the curvature of the column the specimen must be drawn in the same position as the first. Only two of the infrabasals are seen; the third was probably quite concealed by this plate. The columnals have increased considerably in breadth, assuming the shape of a half moon, their transformation into the ring-shaped form taking place in the same way as in *Antedon*. In this stage some very small calcareous grains are seen between some of the normal columnals, especially between the fifth and sixth and sixth and seventh. These perhaps may represent new columnals interpolated between those first formed. However, it is by no means certain that they are really intercalated columnals. On some of the columnals small separate pieces are seen apparently soldered to the main piece of the ossicle, and Mortensen was inclined to believe that this is the ultimate destiny of all these small separate pieces, even the fairly large one lying between the sixth and seventh columnals counting from the terminal plate. Seeliger found such intercalation to occur in *Antedon*, but only between the second to third upper (younger) columnals, and only where the distance between the columnals is greater than usual. Mortensen says this evidently means that there is merely a shifting in the time for the first appearance of the columnals.

In an embryo 40 hours old the skeletal plates have grown considerably, forming large fenestrated plates. The infrabasals are fairly large fenestrated plates hidden by the overlying basals, though seen quite distinctly on close observation. They do not appear to be of different sizes. The number of columnals appears to be ten.

In a normal embryo shortly after fixation the oral and basal plates have assumed their final position, forming the calyx, and the columnals have begun to increase in length. There are ten of these, the uppermost mostly hidden by the basals. The infrabasals can not now be seen because of the opaqueness of the embryo. The vestibulum has not yet opened. There is only a depression showing the position of the future opening.

On the fully formed young pentacrinoid the orals have separated and the tentacles are protruding. As yet no new columnals have appeared. The terminal stem plate has developed into a fairly large, irregular, roundish disk consisting of a thick reticulate network. The orals and basals are beginning to form reticulations. It is a conspicuous feature that the upper edge of the basals embraces the lower edge of the orals.

In the oldest stage studied by Mortensen the anal has been formed, but as yet there are no traces of the radials. The basals are still seen to have at their upper edge a wider circumference than that formed by the orals, so that there is a characteristic offset between the two circlets of calyx plates, a feature that does not appear to be due to the preservation. The plates are already considerably thickened, strongly reticulated, their surface appearing coarsely spinous when seen in profile. Mortensen said that on the whole this pentacrinoid is by no means such a beautiful, delicate looking object as are several other pentacrinoids—for instance that of *Hathrometra prolixa*. The orals are but very slightly concave. There are now thirteen columnals, three new ones having formed at the upper end of the column. These uppermost columnals are conspicuously thickened in the middle, a feature that gradually disappears on the lower columnals. From the seventh to eighth there is no thickening in the middle of the columnals, which are now simply cylindrical. A dark line across the middle still indicates the originally formed plate from which the columnal develops by means of vertically growing processes which unite by cross beams, as described by Seeliger in *Antedon*. The final shape of the columnals, as well as their ultimate number in the fully grown pentacrinoid remains unknown. The terminal stem plate is an irregular disk with some short rounded prominences. The infrabasals are now considerably thickened, and are destined to form, together with the uppermost columnal, the centrodorsal.

A young specimen with the arms 10 mm. long was found by Dr. H. L. Clark, who gave it to Dr. Mortensen. The diameter of the disk was 2 mm. There were ten pinnules on each arm, and the cirri were XIII. The tentacles are studded with small simple spicules, generally lying in a series along one side. The orals are still fairly large, and are of a very peculiar shape, with a prominent point bent inward toward the mouth. The skin of the disk contains numerous fenestrated plates, among which is a large anal. The primary hydropore is seen in the anal interradius. Each of the other interradii has some five to ten hydropores, though in the anal interradius there is still only the primary pore. A larger plate is found in the lower part of each interradius, in the angle between the IBr series. The basals have already completely disappeared from the exterior of the calyx and formed the rosette, as may be seen from the inside. The first cirri are seen to be radial in position.

In fully grown specimens the orals, as well as all the other fenestrated plates have disappeared, and the skin has become studded with small more or less bone-shaped spicules inextricably entangled.

Parasites.—Mortensen wrote that an interesting fact in connection with *Tropiometra carinata* as it occurs in Tobago is that none of the specimens proved to be infested with myzostomes. He remarked that this would seem to indicate that the colony living here must be an isolated one, originating from larvae carried thither by the currents, not in direct connection with the main habitat of the species in American waters, which should probably be sought to the south of the Orinoco and Amazon Rivers. He recalled that we know from the work of von Graff that individuals living there are infested with myzostomes, for he recorded *Myzostomum gigas* from specimens dredged by the *Challenger* off Bahia. Mortensen was inclined to doubt the correctness of the identification of the myzostomes from Bahia, for this species is otherwise known only from the arctic *Heliometra glacialis*.

Localities.—Marine Investigations in South Africa; Rocky Bank, False Bay, Cape of Good Hope; 31–49 meters; rocks; reference No. 15610 [Bell, 1905; A. H. Clark, 1913] (2, B. M.).

Marine Investigations in South Africa; Rocky Bank, False Bay; 31 meters; rock and coral; reference Nos. 15597 and 15598 [Bell, 1905; A. H. Clark, 1913] (3, B. M.).

Rocky Bank, False Bay, Cape of Good Hope [A. H. Clark, 1911]. This refers to the two preceding localities.

Simons Town, False Bay, Cape of Good Hope; *Gauss*, July 2, 1903 [A. H. Clark, 1915] (1, Berl. Mus.).

Dr. Th. Mortensen's station 66; False Bay; 31 meters; stones; December 19, 1929 [Gislén, 1938].

Cape of Good Hope [A. H. Clark, 1913] (1, B. M.).

Cape of Good Hope station 4801 (2 [cotypes of *Antedon capensis*], M. C. Z., 317).

Marine Investigations in South Africa; off Algoa Bay, close to Riy Bank (lat. 33°58′ S., long. 25°51′30″ E.); 46 meters; dark sand, black specks, and rocks; reference No. 508B [Bell, 1905; A. H. Clark, 1911].

Itongazi River, Natal, bearing N. W. ¾ W., 3 miles distant; 46 meters; sand and stones; P. F. 12405–c [H. L. Clark, 1923].

Tugela River mouth bearing N. W. by W., 3½ miles distant; 26 meters; rocks; reference No. 11386 [Bell, 1905; A. H. Clark, 1911].

Marine Investigations in South Africa; Durnford Point, Natal, bearing N. E. by E., 9 miles distant; 25 meters; sand and shell; reference No. 11801 [Bell, 1905; A. H. Clark, 1911, 1913] (25, B. M.).

Marine Investigations in South Africa; station 96 [A. H. Clark, 1913] (2, B. M.).

Marine Investigations in South Africa; stations 97, 98, 155 [A. H. Clark, 1913] (2, B. M.).

Marine Investigations in South Africa; station 160 [A. H. Clark, 1913] (2, B. M.).

Marine Investigations in South Africa; station 165 [A. H. Clark, 1913] (1, B. M.).

South Africa [A. H. Clark, 1909, 1914]. This refers to previous records from south and southeastern Africa.

Delagoa Bay, Portuguese East Africa; K. H. Barnard, October, 1912 [H. L. Clark, 1923].

Mozambique; low tide; K. H. Barnard; November 1912 [H. L. Clark, 1923] (1, M. C. Z., 748).

Portuguese East Africa [Gislén, 1933].

Pieter Faure stations 2001 and 2012; Portuguese East Africa; ?1925 [Gislén, 1938].

Zanzibar; Count von der Decken [von Martens, 1869; A. H. Clark, 1912, 1914] (1, Berl. Mus., 1636).

Zanzibar [Pourtalès, 1878; Rathbun, 1879; P. H. Carpenter, 1881, 1888; de Loriol, 1893; Ludwig, 1899; Hartlaub, 1912; A. H. Clark, 1911, 1912, 1914, 1915; H. L. Clark, 1923] (62, U. S. N. M., 35438; M. C. Z., 73, 310, 315).

Zanzibar [Rathbun, 1879; A. H. Clark, 1914] (3, Y. M.).

Zanzibar [P. H. Carpenter, 1881, 1888; de Loriol, 1893; Ludwig, 1899; A. H. Clark, 1911, 1912, 1913, 1914, 1915] (7, B. M.).

Zanzibar [A. H. Clark, 1909, 1914] (1, C. M.).

Zanzibar [A. H. Clark, 1911, 1914] (2, P. M.).

Zanzibar; C. Cooke, Edward Rosse, and Cheney Webb, 1862, 1868 [Hartlaub, 1912].

Réunion [A. H. Clark, 1912; H. L. Clark, 1923].

Madagascar; Dr. Johan Maria Hildebrandt [P. H. Carpenter, 1881, 1888; de Loriol, 1893; Ludwig, 1899; Hartlaub, 1912; A. H. Clark, 1911, 1912, 1914, 1915] (1, Berl. Mus., 2546).

Mauritius (Ile de France); M. Mathieu [Lamarck, 1816; de Blainville, 1818, 1830, 1836; Lamouroux, 1824; Eichwald, 1829; Dujardin, 1837; J. Müller, 1840, 1843, 1849; Deshayes and Milne-Edwards, 1840; Dujardin and Hupé, 1862; P. H. Carpenter, 1877, 1879, 1881, 1883, 1884, 1888; Rathbun, 1879; Bell, 1882; Pourtalès, 1878; A. H. Clark, 1908, 1911, 1912; Hartlaub, 1912].

Mauritius; M. Julien Desjardins, 1831 [Michelin, 1845; A. H. Clark, 1911] (6, U.S.N.M., 36163; P. M.).

Mauritius; from the Michelin collection (collected with the preceding by M. Julien Desjardins in 1831) [A. H. Clark, 1911] (2, P. M.).

Mauritius; M. Guérin-Méneville (collected with the two preceding lots by M. Julien Desjardins in 1831) [Michelin, 1845; J. Müller, 1849; P. H. Carpenter, 1881, 1884; Hartlaub, 1912; A. H. Clark, 1912; H. L. Clark, 1923] (1, Berl. Mus., 1038).

Mauritius [A. H. Clark, 1912] (1, Berl. Mus., 1037).

Fouquet reef, Mauritius; Prof. Karl Möbius [P. H. Carpenter, 1881, 1882, 1884; Hartlaub, 1912; Reichensperger, 1912; A. H. Clark, 1912] (26, U.S.N.M., 35437; Berl. Mus., 5349).

Mauritius; M. V. de Robillard [de Loriol, 1893].

Mauritius [P. H. Carpenter, 1888; A. H. Clark, 1911, 1912, 1913, 1915] (2, B. M.).

Mauritius (5, M. C. Z., 318, 334).

Mauritius [P. H. Carpenter, 1882, 1884, 1888; A. H. Clark, 1912] (2, H. M.).

Farquhar atoll, north reef; *Sea Lark;* Prof. J. Stanley Gardiner [Bell, 1909; A. H. Clark, 1911, 1912, 1915].

Seychelles; M. L. Rousseau, 1841 [Dujardin and Hupé, 1862 (as *Comatula bicolor,* without locality); P. H. Carpenter, 1879, 1881, 1884, 1888; de Loriol, 1893; Ludwig, 1899; A. H. Clark, 1911, 1912, 1914, 1915; Hartlaub, 1912; H. L. Clark, 1923] (1, P. M.).

Seychelles; 27 meters; *Sea Lark;* Prof. J. Stanley Gardiner [Bell, 1909; H. L. Clark, 1923].

Mascarene Islands [von Martens, 1869; A. H. Clark, 1911, 1912]. This covers earlier references to Mauritius.

Cargados Carajos; 55 meters; *Sea Lark;* Prof. J. Stanley Gardiner [Bell, 1909; A. H. Clark, 1911, 1912, 1915].

Indian Ocean [P. H. Carpenter, 1888]. This refers to all the localities from Java and Ceylon to East Africa from which species of *Tropiometra* have been recorded.

East Africa [A. H. Clark, 1909, 1914]. This refers to the records from the southeastern coasts of Africa and the islands in the western Indian Ocean.

Venezuela [P. H. Carpenter, 1888; de Loriol, 1893; Hartlaub, 1912; A. H. Clark, 1914].

Trinidad, British West Indies; A. H. Clark, 1901.

Trinidad, British West Indies; Beacon B–8; Herbert H. Brown (2, U.S.N.M.).

Tobago, British West Indies; Buccoo Bay; H. L. Clark, 1916 [H. L. Clark, 1916, 1917].

Tobago; Buccoo Bay and Buccoo reef; shallow water; H. L. Clark, 1916 [H. L. Clark, 1919] (35, M. C. Z., 728, 729, 730).

Tobago; reefs near Pigeon Point; H. L. Clark, 1916 [H. L. Clark, 1916].

Tobago; Pigeon Point; shoal water near shore; temperature about 28° C.; H. L. Clark [F. W. Clarke and Wheeler, 1922].

Tobago; coral reef at the western end of the island; Th. Mortensen, March 23 to April 23, 1916 [Mortensen, 1916, 1920; Gislén, 1933].

Tobago [H. L. Clark, 1923]. This refers to the localities just given.

Off St. Lucia, British West Indies (lat. 13° 52′ N., long. 61° 07′ W.); 508 meters; cable repair ship *Investigator*, Capt. E. Cole, 1879 [P. H. Carpenter, 1888; de Loriol, 1893; A. H. Clark, 1909 (also, 1909, as West Indies and as Lesser Antilles); 1914; Hartlaub, 1912; H. L. Clark, 1923 (as West Indies)] (3+, M. C. Z., 320, 749).

Off the mouth of the Amazon River (lat. 0° 25′ S., long. 46° 44′ W.) [A. H. Clark, 1912] (11, H. M.).

Thirty-three miles east of Pernambuco, Brazil; 42 meters [A. H. Clark, 1913] (3, B. M.).

Rio Formoso, Pernambuco, Brazil [Rathbun, 1879; P. H. Carpenter, 1881, 1888; Hartlaub, 1912].

Bay of Bahia (Bahia de Todos os Santos), Brazil, at many localities [Rathbun, 1879].

Bahia, Brazil; 13–36 meters; *Challenger*, 1873 [P. H. Carpenter, 1880, 1881, 1883, 1884, 1887, 1888, 1891; von Graff, 1884; Perrier, 1886; Braun, 1888; Hamann, 1889; A. H. Clark, 1908, 1913; Hartlaub, 1912; Reichensperger, 1912, 1913] (11, B. M.).

Bahia, Brazil; 36 meters; *Challenger*, 1873 [A. H. Clark, 1911, 1913] (1, B. M.).

Abrolhos Islands, Brazil; Prof. Ch. Fred. Hartt, 1867 [Verrill, 1868; Rathbun, 1879; P. H. Carpenter, 1888].

Off the Abrolhos Islands; 55 meters; U. S. Coast Survey steamer *Hassler*, January 20, 1872 [P. H. Carpenter, 1888; Hartlaub, 1912].

Guaraparim, Brazil (about lat. 20°45′ S.); Prof. Louis Agassiz; Nathaniel Thayer expedition to Brazil, 1865 [Pourtalès, 1879; A. H. Clark, 1908, 1911, 1912] (7, M. C. Z., 69).

Victoria, Brazil; Prof. Louis Agassiz; Nathaniel Thayer expedition to Brazil, 1865 [Pourtalès, 1879; A. H. Clark, 1908, 1911, 1912] (1, M. C. Z., 316).

Among the Baleiro Islands, off the harbor of Victoria, province of Espirito Santo, Brazil [A. H. Clark, 1912] (7, H. M.).

Rio de Janeiro; M. Claude Gay, 1829 [Gay, 1854; Dujardin and Hupé, 1862;

P. H. Carpenter, 1881, 1888; A. H. Clark, 1911; Hartlaub, 1912 (all as Chile); P. H. Carpenter, 1884 (as Pacific coast of South America)] (11, U.S.N.M., 35408; P. M.).

Rio de Janeiro; United States Exploring Expedition under Commander Charles Wilkes, U. S. Navy; collected by Charles Pickering and Titian Ramsay Peale during the six weeks ending January 7, 1839 [Minckert, 1905 (locality not given); A. H. Clark, 1909 (as South Pacific Ocean), 1911 (as South Pacific Ocean, South Sea Islands, Marshall Islands, Queensland, and ?Australia), 1914 (as ?Fiji, ?Kingsmill Islands); Hartlaub, 1912 (as Fiji, and as ?Fiji, ?Kingsmill Islands); Reichensperger, 1912 (as Fiji)] (3, U.S.N.M., 2706, 2707; M. C. Z., 75).

Rio de Janeiro; A. W. Greeley (1, L. S.).

Rio de Janeiro; Charles Darwin, April 4 to July 5, 1832 [A. H. Clark, 1913] (1, B. M.).

Rio de Janeiro [Verrill, 1867, 1868; Rathbun, 1879; P. H. Carpenter, 1881, 1888; de Loriol, 1893; A. H. Clark, 1907, 1909, 1911; Hartlaub, 1912].

Rio de Janeiro; Prof. Louis Agassiz; Nathaniel Thayer expedition to Brazil, 1865 [Pourtalès, 1879; A. H. Clark, 1908, 1911, 1912] (230+, U.S.N.M., 35409 [6 six-rayed], 35410, 36239; M. C. Z., 68, 70, 118, 309, 311 [9 six-rayed], 321).

Rio de Janeiro; Emil Selenka [A. H. Clark, 1912] (42, U.S.N.M., 17755, 35412, 35472; Berl. Mus., 1826, 2690).

Rio de Janeiro; U. S. Coast Survey steamer *Hassler* [A. H. Clark, 1908] (25, M. C. Z., 312, 313, 319).

Rio de Janeiro [A. H. Clark, 1908] (2, M. C. Z., 71, 74).

Rio de Janeiro [A. H. Clark, 1912] (1, H. M.).

Rio de Janeiro [A. H. Clark, 1913] (3, B. M.).

Rio de Janeiro (6, Y. M.).

Ilha de São Sebastião (lat. 23°48′ S.) [von Ihering, 1897].

Santos, Brazil [A. H. Clark, 1912] (10, H. M.).

Santa Catarina (or Catharina) Island, Brazil (about lat. 28° S.) [A. H. Clark, 1912, 1914] (2, Berl. Mus., 2875).

Coast of Brazil [Pourtalès, 1878; Rathbun, 1879; P. H. Carpenter, 1879; Ludwig, 1882]. This refers to one or more of the localities given above.

Coast of Brazil; Richard Rathbun, 1875–'77 (1, U.S.N.M., 35411).

Coast of Brazil (1, L. S.).

Brazil (5, M. C. Z., 72; Berl. M.).

Atlantic coast of South America [P. H. Carpenter, 1884]. This refers to all the records previously published.

East coast of South America [A. H. Clark, 1914]. This refers to all the previously published records.

Brazil [A. H. Clark, 1909]. This refers to the records previously published.

West Rock, St. Helena; Ruben G. Coffin, U. S. S. *Eclipse*, February 26, 1890 [A. H. Clark, 1911] (1, U. S. N. M., 17471).

St. Helena; E. W. Alexander [P. H. Carpenter, 1881, 1888; de Loriol, 1893; A. H. Clark, 1911, 1913, 1914; Hartlaub, 1912; H. L. Clark, 1923] (2, B. M.).

James Bay, St. Helena; 36 meters; stone and shell; Dr. Th. Mortensen, January 29, 1930 [Gislén, 1933].

Jamestown, St. Helena; rocky coast; Dr. Th. Mortensen, February 1, 1930 [Gislén, 1933].

Jamestown, St. Helena; 36 meters; Dr. Th. Mortensen, February 4, 1930 [Gislén, 1933].

Sea-cow Cove, St. Helena; 27 meters; Dr. Th. Mortensen, February 11, 1930 [Gislén, 1933].

Prosperous Bay, St. Helena; rocky coast; Dr. Th. Mortensen, February 17, 1930 [Gislén, 1933].

No locality [P. H. Carpenter, 1888; Bather, 1889; Bateson, 1894; A. H. Clark, 1908]. This is the 6-rayed specimen in the British Museum; it probably came from Rio de Janeiro.

No locality [Leach, 1815; Leuckart, 1833; J. Müller, 1841, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1879, 1888; A. H. Clark, 1908, 1911, 1912].

No locality [J. E. Gray, 1826].

No locality [(Leach), 1830].

No locality; M. Cloué, 1847 [A. H. Clark, 1911] (1, P. M.).

No locality; probably Brazil (1, U. S. N. M., 35407).

No locality [P. H. Carpenter, 1882; A. H. Clark, 1912] (2, H. M.).

No locality [A. H. Clark, 1913] (1, B. M.).

No locality [A. H. Clark, 1913] (4, B. M.).

No locality (4, E. I.).

Doubtful locality.—Saya de Malha; 548–914 meters; *Sea Lark;* Prof. J. Stanley Gardiner [Bell, 1909; A. H. Clark, 1911, 1912, 1915].

Erroneous localities.—Chile (or Chili) [Gay, 1854; Dujardin and Hupé, 1862; P. H. Carpenter, 1881, 1888; A. H. Clark, 1911; Hartlaub, 1912]. In reality Rio de Janeiro; see first mention of that locality above.

Chile; M. Gay, 1829 [A. H. Clark, 1911]. Same as preceding.

Pacific coast of South America [P. H. Carpenter, 1884]. Same as preceding.

Panama; U. S. Coast Survey Steamer *Hassler* (1, M. C. Z., 314). This specimen was undoubtedly collected on the Brazilian coast. It was shipped home from Panama. Other specimens in the *Hassler* collection were similarly mislabeled.

Valparaiso [P. H. Carpenter, 1888, p. 34]. This refers to Gay's specimens from "Chile."

Note.—The three specimens collected by the United States Exploring Expedition that I have examined, labeled South Pacific Ocean (U. S. N. M., 2706 and 2707) and Pacific Ocean (M. C. Z., 75), are typical examples of *Tropiometra carinata* as it occurs at Rio de Janeiro. This expedition spent the six weeks ending January 7, 1839, at Rio de Janeiro. It stayed for some time in Fiji in 1840. On leaving Fiji for the Hawaiian Islands the *Peacock* was detached and went to Hawaii by way of the Kingsmill (=Gilbert) Islands, among which it remained from April 1 to May 1, 1840. The specimens collected by this expedition became badly mixed so that the labels are quite unreliable. As the specimens of *Tropiometra* are undoubtedly *T. carinata* and agree with others from Rio de Janeiro, and as none of the smaller forms in this genus are known from farther east than Java, it is a logical conclusion that the specimens labeled South Pacific Ocean, Pacific Ocean, Fiji, and Kingsmill Islands were actually all collected during the long stay of the expedition at Rio de Janeiro.

Geographical range.—Cargados Carajos, the Seychelles, Farquhar Atoll, Mauritius, Madagascar, and Réunion, and the coasts of eastern and southern Africa from Zanzibar to False Bay, Cape of Good Hope; St. Helena; from Santa Catarina Island, southern Brazil (lat. about 28° S.) northward to Venezuela, Trinidad, Tobago, and St. Lucia, British West Indies.

Bathymetrical range.—From the shore line down to 55 meters in both the Indian and Atlantic Oceans; there is a single record of 508 meters off St. Lucia.

Occurrence.—Dr. Hubert Lyman Clark said that at Tobago he first found this species in Buccoo Bay, where it occurs in water from a few inches to several feet in depth at low tide; indeed, at the lowest tides some individuals are probably out of the water, in part at least, for a short time.

The bottom which they frequent is made up largely of *Porites* fragments, usually more or less covered by a growth of *Corallina* and *Halimeda*. Scattered over it there is also a sparse growth of short eelgrass (*Zostera*).

As a rule the comatulids hold themselves in an erect position by means of their stout cirri, which are customarily grasping a bit of *Porites*. Sometimes the body is more or less completely shaded by a clump of eelgrass or seaweed, but this is not usually the case. Generally the individuals are solitary, but occasionally five or six may be found about a single clump of *Porites* or of eelgrass. Now and then he found individuals living beneath slabs and large fragments of coral; this was particularly true on Buccoo reef, where, later, a number of specimens were discovered. All were in shaded places, suspended arms down and not in the usual erect position.

These comatulids are not really abundant, but twenty or more may be gathered in half an hour or less.

All the other recorded captures are from hard bottom—reefs; rocks; rocks and coral; sand and shells; dark sand; black specks and rocks.

History.—William Elford Leach in 1815 described *Alecto carinata* from a specimen from an unknown locality in the British Museum in the following terms: "Rays above, with a carina of spines, the ciliae compressed; tentacules of the back very slightly regulose, the joints simple, and of moderate length." This description could apply only to a species of *Tropiometra*, as is conclusively shown by the mention of the "carina of spines"—that is, a series of high more or less spine-like carinate processes—and the compressed "ciliae" or pinnules. Leach's specimen can no longer be found. As he emphasized the carination, which to him suggested a series of spines, his specimen must have represented one of the more strongly carinate forms and therefore presumably came either from South Africa or the more or less closely adjacent islands, or from Brazil.

In March 1816 Lamarck described *Comatula carinata* from a specimen in the collection of M. Dufresne that had been collected at the Île de France (Mauritius) by M. Mathieu. Lamarck's description reads: "C. radiis pinnatis basi bifidis, denis, dorso obsoletè carinatis; articulis imbricatis; cirrhis dorsalibus vigesinis." He added in French that this species has 10 pinnated rays and 20 dorsal cirri. Under *Comatula carinata* he placed de Fréminville's *Antedon gorgonia* as a synonym, with a question mark.

In an article on the digestive organs of the genus *Comatula* published in November 1826, John Edward Gray, after describing the mouth, ambulacral grooves, and anal cone of *Comatula mediterranea* (=*Antedon mediterranea*) said that "since that time, having had an opportunity of examining *C. carinata*, Lamarck, or a very closely allied species, I find nearly the same structure, but that the tubular proboscis is bent down toward the center as if by a suture, so that the openings are very close together, and the muscular ridges are stronger both on the abdominal integument and on the fingers; and it appears to be this part which forms the fringe of them."

In 1830 a preparation of a specimen of *Alecto carinata* was listed as being in the Museum of the Royal College of Surgeons of London. This may have been the specimen mentioned by Gray.

Edward Griffith in 1834 published two colored figures of a species identified as *Comatula carinata*. One of these is a ventral view of the animal with the arms extended. It lacks detail and is not identifiable. The other represents the proximal portion of an animal as far as about the twentieth brachial, and is an excellent likeness of *Amphimetra tessellata discoidea* (see Part 4a, p. 376). It is a copy of a figure originally published by Guérin-Méneville in his "Iconographie du règne animal" (1828–1837), though no hint of this is given.

Prof. Johannes Müller, in April 1840, noted that there are 2-5 brachials between the syzygial pairs in *Comatula carinata*. In 1841 he gave a list of the six ten-armed comatulids described up to that time that he considered as valid species. The first of these was *Alecto carinata*, under which he included as a synonym the *Comatula carinata* of Lamarck, and to which he referred the figures given by Griffith on plate 8.

In 1843 Müller published, under the name *Alecto carinata*, a redescription of Lamarck's types of *Comatula carinata* which was drawn up from notes made for him at the Paris Museum by Franz Hermann Troschel. He gave the characters as follows: 10 arms. About 35 cirri on the centrodorsal, composed of 24 segments without dorsal processes. The brachials are short, broader on the distal than on the proximal end, and therefore imbricating. The dorsal side of the brachials is carinate, and there is a tubercle on the distal border on the dorsal side. Two to 5 brachials between the syzygial pairs. The 8-9 lowest pinnules on each side are somewhat the larger; they gradually increase from the first to the eighth or ninth, then decrease again. The segments of the pinnules, especially on the thicker part of the arm, are short, broader than long, laterally flattened, and provided along the whole length of the outer side with a sharp edge. The skin of the disk is naked. About 8 inches (200 mm.) in diameter.

In his memoir on the structure of *Pentacrinus caput-Medusae* (=*Cenocrinus asteria*) published in 1843 Müller said that the pinnules of *Alecto carinata* are flat, and especially the lower ones are strongly broadened.

In 1845 Hardouin Michelin published, under the direction of Félix Edouard Guérin-Méneville, a list of the zoophytes, echinoderms, and starfishes that had been collected at Mauritius by Julien Desjardins, including with these others from the collection of Colonel Mathieu, and from the collection of the Paris Museum. Among the species recorded from M. Desjardin's collection was *Comatula carinata* Lamarck.

In 1849 Müller, under the heading *Comatula* (*Alecto*) *carinata*, repeated the revised description he had published in 1843. He gave Île de France as the habitat of the species and listed the Berlin and Paris Museums as repositories of specimens. He credited the species to Lamarck but placed Leach's *Alecto carinata* without question in the synonymy. He again referred to the figures on Griffith's plate 8.

In 1854 Claude (or Claudio) Gay described in detail a new species which he called *Comatula picta;* he gave Chile as the habitat of this new species. The specimens upon which he based this new species had been sent to the Paris Museum from South America by himself many years before, and when he came to look them up in the course of his work on the zoology of Chile he found them there bearing the manuscript name *Comatula picta*, which had been given them by Achille Valenciennes. I examined these specimens at the Paris Museum in 1910. There are 11 of them, and they are labeled "*Comatula picta;* Chili; M. Gay, 1829." This species does not occur in Chile, and it is therefore important to determine the true place of origin of Gay's specimens, which are of the common Brazilian type.

Gay was a French botanist and traveler, born at Draguignan in 1800. He went to Paris and devoted himself to the study of the natural sciences, especially botany, zoology, and geology, later traveling in Greece, Asia Minor, and a part of the Orient. He was appointed professor of physics and chemistry in 1828 and in that year left for Chile, primarily for the purpose of studying in the field the rich flora and fauna of that country. On his way to Chile he stopped at Rio de Janeiro where, devoting his attention especially to botany, he made a collection of more than 400 plants, which were described by Adrien de Jussieu (in Augustin F. C. P. de Saint-Hilaire, with Adrien de Jussieu and J. Cambessedes, Flora Brasiliae Meridionalis, Paris, 1825–1833; cited by Gay as Jussieu, Flore du Brésil). But at Rio de Janeiro he also made collections of insects, shells, and other animals. In a letter published in 1833 (Ann. Sci. Nat., vol. 28, 1833, p. 371) he remarked that near Rio de Janeiro fresh water and marine shells—*Ampullaria*, *Mytilus*, and *Solen*—live mixed together in brackish water. Later Charles Darwin, in mentioning the intricate wilderness of lakes near Mandetiba, east of Rio de Janeiro (Journal of Researches, 1871, p. 21), said that in some the shells were fresh-water forms, in others marine, and noted that Gay had found both fresh-water and marine shells mixed in brackish water in the neighborhood of Rio. Gay was in Rio in 1829 and did not reach Chile until 1830. We have his own statement to the effect that he devoted much time to making collections in the neighborhood of Rio, collections both of plants and of animals.

As his specimens in the Paris Museum are dated 1829, and Rio was the only place where he collected extensively in that year, and the only place visited by him on the coast of South America where this species occurs, it is a logical conclusion that the specimens in the Paris Museum upon which *Comatula picta* was based came originally from Rio. They were probably received at the Museum in a shipment from Chile and erroneously assumed to have been collected there. The specimens remained at the Museum many years before they were studied, and in this long interval Gay might very well have forgotten the exact place where he had collected them, as he was not especially interested in the echinoderms. While they were awaiting his return M. Valenciennes gave them the manuscript name of *Comatula picta*.

The description of *Comatula picta* is very good and shows a considerable knowledge of the comatulids on the part of the writer—or at least on the part of the one who prepared the notes from which it was drawn up. I suspect that it was based upon notes provided by Valenciennes. Valenciennes never described any crinoids, but he gave manuscript names to many of the new species that he found in the collection of the Paris Museum, and these names were later adopted by Johannes Müller. Gay said that Hupé had assisted him in the preparation of his work on the zoology of Chile, and Dr. R. A. Philippi [1] indicated that Hupé was chiefly responsible for this portion of the work. Gay's description of *Comatula picta*, therefore, was presumably drawn up by Hupé. But if this is true it seems strange that he should have referred to *picta* as merely a manuscript name in Dujardin and Hupé, 1862.

Gay described *Comatula picta* as follows:

> C. radiis incrassatis, pinnatis, decem, dorso obsoletè carinatis et tuberculatis; cirrhis dorsalibus 24; brachiis in pinnulis rubro et fusco articulatis.
>
> *C. picta* Val., Coll. du Mus.
>
> Especie de radios espesos, articulados, en número de diez, cargados de pínulas bastante delgadas; estos radios llevan en el medio de su faz dorsal una carena poco marcada, sobre la cual existe una serie de tuberculillos salientes y puntuados. Los brazos ó las cirras dorsales son delgados, articulados, desiguales y en número de veinte y cuatro. Toda la extension del brazo y de las cirras dorsales está como articulada por manchas anulares, anternativamente encarnadinas y pardas.
>
> Esta linda especie de Comátula es hasta cierto punto vecina del *C. carinata* Lamk. Sus brazos ó radios son espesos y carnudos como en esta especie, pero difiere de ella por su coloracion sumamente elegante, que consiste en manchas anulares de un bruno encarnadino el cual cubre toda la estension de los radios y de las pinulas. Se halla en Chile.

Under *Comatula carinata* Dujardin and Hupé in 1862 published a translation of the redescription given by Müller in 1843. They included Leach's *Alecto carinata* in the synonymy, and referred to Griffith's plate 8. The diameter of the animal they gave as 216 mm. The habitat was given as Île de France. In a list of manuscript names found with specimens in the Paris Museum they included *Comatula bicolor* and *C. picta*.

In a list of Caribbean crinoids published in 1867 Prof. Addison Emery Verrill included *Antedon braziliensis* Lütken from Rio de Janeiro. In a paper on the corals and echinoderms collected at the Abrolhos reefs, Province of Bahia, Brazil, by Prof. C. F. Hartt in 1867, published in February 1868, Professor Verrill said, under the heading *Antedon dubenii*, that one specimen, apparently identical with this species, was obtained at the Abrolhos. Its color is deep purple with large spots of yellowish white on the sides of the rays. It is very different from a specimen of *A. braziliensis* Lütken, from Rio de Janeiro sent to the Museum of Yale College by Dr. Lütken with which he compared it.

Prof. Edouard von Martens in 1869 mentioned *Comatula carinata* from the Mascarene Islands (=Mauritius), and recorded *Comatula solaris* from Zanzibar. This last was in reality the present species.

In the article published on January 4, 1877, Dr. P. H. Carpenter said that de Fréminville's *Antedon gorgonia* is probably the same as Lamarck's *Comatula carinata*. It is, however, a synonym of *Antedon bifida*.

In a paper on the corals and crinoids collected by the United States Coast Survey steamer *Blake*, published on December 14, 1878, Count L. F. de Pourtalès wrote (under the heading *Antedon meridionalis*) that a species common on the coast of Brazil answers to the description of *Comatula carinata*. He said that this species is quoted as from Mauritius, and the Museum of Comparative Zoology has specimens from Zanzibar differing only in some minor details from the Brazilian ones. He remarked that he could find no specimens in the collection with the characters of *Antedon dübenii* Böhlsche described as being from Rio de Janeiro.

---

[1] Verh. deutschen Wiss. Ver. Santiago (Chile), vol. 2, No. 4, 1892, p. 246.

In a list of the Brazilian echinoderms, with notes on their distribution and other features, published in June 1879, Dr. Richard Rathbun wrote that the Peabody Museum at Yale University, New Haven, Conn., possesses several specimens of an *Antedon* from Zanzibar which, although he found them undetermined, agree so closely with the original descriptions of *A. carinatus* as to leave little doubt of their identity. He found that the Brazilian specimens that he had been able to study differ from the Zanzibar specimens about as follows: The Brazilian specimen from Rio de Janeiro in the Peabody Museum, which had been received from Dr. C. F. Lütken labeled *Antedon brasiliensis*, has the dorsal side of the arms rather more strongly carinate, the tubercle projecting from the median outer edge of each brachial being usually very strongly marked, and often reaching inward one-half to two-thirds the length of the brachial as a very prominent, slightly elongate, subangular ridge with a minutely spinose surface. The intersyzygial interval is two or three muscular articulations. In the characters of the cirri and of the centrodorsal there are no appreciable differences. The specimens from Bahia and Pernambuco, on the contrary, differ mostly with regard to the centrodorsal and the cirri. The former is usually proportionately broader and flatter, but it is extremely variable. The cirri are, as a rule, proportionately longer and fewer in number. They are placed in about two irregular rows, or in one crowded row, and range in number from about XV to XXX, on medium sized specimens. They are composed of 19–22 segments each. The total spread of the largest perfect specimen observed was a little over 250 mm. (giving an arm length of 125 mm.). The color varies from a light yellowish brown to a deep violet, with many intermediate shades, specimens being usually banded with lighter and darker colors, and seldom of uniform tint. Rathbun said that the study of a large series of specimens would probably serve to unite the Brazilian with the East African species beyond all doubt.

In his preliminary report upon the comatulids of the *Challenger* expedition published in 1879 Dr. P. H. Carpenter listed *Antedon brasiliensis* as one of the seven species of that collection which he had not been able to identify with any degree of certainty with previously described forms.

In his monograph on the genus *Actinometra* published in December 1879, Carpenter said that Leach's *Alecto carinata* seems to have been the same as de Fréminville's *Antedon gorgonia*, and he also placed *Antedon gorgonia* under *Comatula carinata* Lamarck as a questionable synonym. He listed *Antedon carinata* as one of the 16 species described by Müller that he was able to refer to the genus *Antedon* as redefined by him. In 1880 Carpenter mentioned *Antedon brasiliensis* as an example of a species in which the centrodorsal is a thick disk, almost thick enough to be called columnar, with well-marked upright sides to which the cirrus sockets are limited, the whole (or nearly the whole) of the dorsal surface being free of them. He also described the radials of *A. brasiliensis*, which he regarded as similar to those of *Ptilometra macronema*, and mentioned the muscle plates on the articular faces. He compared the radials of *A. brasiliensis* with those of a new fossil species, *Antedon prisca*.

In a preliminary report upon the comatulids of the *Blake* expedition published in

1881 Carpenter said that through the kindness of Professor Möbius of Kiel he had been enabled to examine specimens of *Antedon carinata* from Mauritius, which he said was the original locality of Müller's type specimens that Prof. E. von Martens had courteously permitted him to study in the University Museum at Berlin. He said he had also seen specimens from Madagascar and the Seychelles, and mentioned the dissected calyx of a specimen from Zanzibar. He regarded specimens from Brazil, Chile, St. Helena, the Red Sea, and Aden as specifically identical with *carinata*. He remarked that Lütken had given the manuscript name *Antedon brasiliensis* to a 10-armed comatulid that is abundant on the coast of Brazil. He noted that Pourtalès and Rathbun had considered this as a synonym of Lamarck's *Comatula carinata* and added that although he was at first inclined to follow Lütken in separating the two types further study had led him to believe in their specific identity. This conclusion was confirmed by the resemblance between the dissected calices of specimens from Bahia and from Zanzibar. He said these are so very similar that if they were fossils he would unhesitatingly refer them to the same species. In fact, the Bahia specimens vary considerably among themselves, and there is less likeness between two calices from this locality than there is between one of them and a calyx from Zanzibar. He said that *Antedon carinata* is described by Rathbun as probably ranging along the Brazilian coast to Pernambuco. It was not obtained by the *Blake* at all, but it was found in abundance by Captain Cole of the *Investigator* in 278 fathoms off St. Lucia, so that it may fairly be considered as belonging to the Caribbean fauna.

In a paper on the comatulids of the Leyden Museum published in 1881 Carpenter gave a synonymy of *Antedon carinata* (Lamarck) in which he included, with a question mark, de Fréminville's *Antedon gorgonia*, Leach's *Alecto carinata*, and, without any qualification, Lütken's *Alecto braziliensis* and Verrill's *Antedon dübenii*. After the name *Alecto braziliensis* he wrote "Lütken, MS., 1865?," indicating that Lütken had first used that name at about that time; but it was never published by him. In a paper on the comatulids of the Hamburg Museum published in 1882 Carpenter said that this museum contains two dry specimens of *Antedon carinata* from Mauritius that are remarkable for the very slight carination of the dorsal surface of the arms, and remarked that had Lamarck's original specimens been like these he would assuredly never have given them the specific name *carinata*. Two other specimens without locality have as many as XXX cirri, a larger number than is found on specimens from Mauritius, while the pinnules are considerably stouter and more fleshy than in the type, the lower ones especially having broader basal segments. These last may not be true *carinata*. As *carinata* he also recorded four specimens from Java, which are herein considered as representing *clarki* (p. 285).

In a memoir on the echinoderms collected by Prof. E. van Beneden on the coast of Brazil published in 1882 Prof. Hubert Ludwig said that *Antedon carinata* is common on the coast of Brazil. In the same year Prof. F. Jeffrey Bell proposed a specific formula for *Antedon carinata* which was emended by Carpenter early in the year following.

In 1883 Carpenter said that he had found *Antedon carinata* much more favorable for the study of the finer anatomical details than *A. bifida*. The material with which he worked came from Bahia.

Prof. Ludwig von Graff in 1884 recorded *Myzostomum gigas* from specimens of *Antedon carinata* that had been collected by the *Challenger* at Bahia.

In the *Alert* report published in 1844 Professor Bell mentioned *Antedon carinata* as a species with an exceedingly wide range comparable to that of *Actinometra* (= *Comanthus*) *parvicirra.*

In the *Challenger* report upon the stalked crinoids published in 1884 Carpenter said that *Antedon carinata* is a widely distributed species occurring both on the Atlantic and on the Pacific coasts of South America, at Java, Mauritius, the Seychelles, and elsewhere. He remarked that the *Challenger* had found it to be very plentiful off the coast of Bahia, and gave notes on the anatomy based upon specimens from that locality. He described the labial plexus in detail and compared it with that of *Antedon bifida.* He said that he had not only found a distinct genital tube within some of the vessels forming the plexus beneath the disk ambulacra, but he had also met with detached portions of ovaries containing more or less fully developed ova in various parts of the body cavity, as for instance in the spaces of the connective tissue network forming the lip, in the intervisceral portion of the body cavity between the two parts of the coiled gut, and in the subtentacular canals between the genital plexus and the water vessels. He gave a figure of a vertical transverse section of the disk in the anal interradius showing the connection between the genital vessels and labial plexus.

Prof. Edmond Perrier in his memoir on the anatomy of *Antedon rosacca* published in 1886 quoted extensively from Carpenter's observations on the anatomy of *Antedon carinata.*

In a paper on the supposed presence of symbiotic algae in *Antedon rosacca* published in 1887 Carpenter said that sacculi are very thick at the sides of the pinnule ambulacra in *Antedon dubeni* (=the young of *carinata*) and *A. carinata,* of which latter species over 100 individuals were obtained by the *Challenger* at Bahia.

In the *Challenger* report upon the comatulids published in 1888 Carpenter included all the forms in the genus *Tropiometra* known to him under *Antedon carinata.* His description of *Antedon carinata* was based at least chiefly, and probably wholly, upon specimens that had been collected by the *Challenger* at Bahia, Brazil, in 7-20 fathoms. His notes on the structure and anatomy were based entirely upon Brazilian specimens, but he dissected the calyx of a single specimen from Zanzibar. The localities he gave for *Antedon carinata* were: Off St. Lucia (278 fathoms); Venezuela; Pernambuco; the Abrolhos Islands; Rio Janeiro; Chile; Java (?); Ceylon; the Seychelles; Muscat; Aden; Red Sea; Zanzibar; Mauritius; Madagascar; St. Helena. The forms occurring at these localities are now determined as follows: Java (?)—*clarki;* the Seychelles, Zanzibar, Mauritius, Madagascar, St. Lucia, Venezuela, Pernambuco, Abrolhos Islands, Rio de Janerio, Chile (in reality Rio de Janeiro; see p. 322), St. Helena—*carinata;* Ceylon—*indica;* Muscat, Aden, Red Sea—*audouini.* In the discussion of the species he mentioned a specimen from Norfolk Island in the Vienna Museum (see p. 287).

Carpenter remarked that this species has a wide distribution in the littoral zone of the tropical and the southern subtropical seas; and it is not improbable, therefore, that it is identical with the *Alecto carinata* of Leach, who defined his type very briefly from a specimen without locality in the British Museum. But the originals of Leach's species are not now to be found in the National Collection, although Prof. F. J. Bell has made a careful search for them; and the identity of his *Alecto carinata* with the *Comatula carinata* from Mauritius which was described by Lamarck in the following year must therefore remain uncertain. He said that Lamarck referred to *Antedon gorgonia* de Fréminville as a possible synonym of his species, and from this one may perhaps conclude that he had been unable to get access to de Fréminville's type. He remarked that we have seen that he had ignored de Fréminville's generic name *Antedon*, which had five years' precedence over *Comatula*, and that his definition of the latter type differed but little from that of *Antedon* which had been previously given by de Fréminville. But the latter author gave no figure or formal description of *Antedon gorgonia* as distinguished from his definition of the genus; and if Lamarck was unable to see de Fréminville's original specimen we can understand his uncertainty respecting the possible identity of *Comatula carinata* and *Antedon gorgonia*.

He regarded the specimens from Rio de Janeiro that had been distributed by Lütken under his manuscript name *Antedon braziliensis*, and those from Brazil doubtfully referred by Verrill to *Antedon dübenii*, as conspecific with *carinata*. The difference, he said, seems to be chiefly in the coloration, and it is now practically certain that Verrill's and Lütken's types alike are identical with the species from the Indian Ocean (*carinata*). He said that in this species the lower pinnules are all of tolerably equal length, and only differ in the proportions of their component segments. The stoutness of the segments increases up to the third outer pinnule (P_3), and the next two or three pinnules are most frequently almost equally stout, but in a few cases the size of the pinnule segments decreases from this point onward. In full-grown individuals the width of the arm remains uniform until the second syzygial pair (composed of brachials 9+10), after which the brachials become more triangular, and the width begins to decrease, while the median keel or crest becomes more distinct. This varies greatly in the extent of its development, and is so slight in some individuals that he has seen from Mauritius, the locality of Lamarck's original specimen, that he would most assuredly never have given them the specific name *carinata*.

Carpenter said that there is always more or less of a tubercular elevation on the junction lines of the elements of the IBr series and the two lowest brachials, and from the second of these onward the median dorsal line of the arm is more or less sharply indicated, owing to the way in which the dorsal surface of each brachial falls away from it, so that the arm has somewhat the appearance of having been compressed laterally. The bases of many arms show little more than this; but in others the middle of the distal edge of each brachial is distinctly raised, and a sharp forward-projecting crest or keel is gradually developed upon it, and continues for some way out on the arms, till it becomes less and less distinct in their terminal portions. He said that in the few specimens that he had seen from Muscat and from the Red Sea this character, and also the tubercular elevations on the radials and lowest brachials are considerably less distinct than in those from the Indian Ocean (that is, Mauritius and more or less adjacent islands, and the southeast African coast), Brazil, or the Caribbean Sea; while both in the African and in the Red Sea variety the terminal portions of the arms have stiffer pinnules and a less feathery appearance than in the Brazilian examples. He remarked that the sacculi are extremely abundant in this species, and occur in considerable quantity at the sides of the ambulacra both on the disk and on the arms. He said that the ambulacra are often supported by delicate rods and spicules of limestone, but there is never anything like a definite skeleton. The color is extremely varied. Some specimens are dark reddish purple or light yellowish brown all over. Others have alternating bands of these two colors, each band covering two or three brachials. In others, again, the bands are quite narrow, while some individuals have a more or less mottled appearance, with the brown occasionally replaced by white. In his discussion of comatulids in general he described the median groove on the ventral surface of the radials, the form of the centrodorsal, the unusually substantial basal rays, and the articular faces of the radials, and said that the ambulacral plating is reduced to small and irregular spicules without definite arrangement.

The description of *Antedon carinata* given by Carpenter in the *Challenger* report seems to have been based entirely upon specimens of *picta* collected at Bahia. It reads as follows:

> The centrodorsal is a thick roughly circular disk with the dorsal surface bare, bearing marginal cirri.
>
> The cirri are XX–XXX, 20–30. The segments are stout, and are all broader than long, the basal ones especially so. The penultimate segment sometimes, but rarely, has a small opposing spine.
>
> The radials are partially visible. The IBr_1 are short and oblong. The IBr_2 (axillaries) are triangular, twice as long as the IBr_1, and forming with them a more or less distinct median tubercle.
>
> The 10 arms are about 125 mm. long. The first two brachials are wedge-shaped (the first least so) with sharp outer edges and a median elevation similar to that on the IBr series in their line of union. The arms consist of about 160 short brachials which are broad and nearly oblong till the second syzygy, after which they are narrower and more triangular, gradually becoming more oblong again and finally square at the ends of the arms. The middle of the distal edge of each brachial in the lower part of the arm is slightly raised, and gradually develops into a keel or crest curving slightly forward. This may follow immediately after the median tubercle between the first and second brachials, or not begin till after the twentieth brachial, and varies much in its development, gradually becoming less marked toward the ends of the arms.
>
> Syzygies occur between brachials 3+4 and from between brachials 9+10 to between brachials 13+14, and distally at intervals of 3–9 (usually about 5 or 7) muscular articulations.
>
> The lower pinnules are all of tolerably equal length. P_1 is about 12 mm. long, rather slender, and consists of some 20 trihedral segments most of which are longer than broad. The pinnules following have rather broader and more flattened segments with a sharp dorsal edge, and they gradually increase in stoutness to P_3, which is the largest pinnule on the arm. The next few pinnules decrease slowly in stoutness, but increase in length, their outer segments becoming relatively longer, but the basal ones remaining broad for some distance. The terminal pinnules are long and filiform.
>
> The disk is 11 mm. in diameter, and is naked. Sacculi are very abundant on the disk, arms, and pinnules.
>
> The color (in alcohol) is very variable, light brown, purple, or various combinations of the two, either mottled or in broad or narrow bands; other specimens are mottled purple and white.

Carpenter said that the centrodorsal of this species is very characteristic. It is a thick disk with a single or partially double row of marginal cirri, but its dorsal surface is smooth and free of cirri, though in young individuals it is more convex, with only a small cirrus free space at the dorsal pole. The ventral surface is marked by an indistinct pentagonal impression, which corresponds to a similar marking on the under surface of the radial pentagon, and is of interest from its foreshadowing to a certain extent the deeper bilobed impressions in the corresponding positions on the centrodorsal and radials of *Heterometra quinduplicava.* He remarked that this species has a well-developed basal star, and the articular surfaces of the radials, though relatively wider than is usually the case in the endocyclic comatulids, are considerably inclined to the vertical axis of the calyx, while there is a wide central funnel the opening of which is often not filled up by any calcareous network, so that the ventral surface of the rosette is more or less visible through it. He said that a few comparatively young specimens were obtained by the *Challenger* at Bahia. These differ from the more mature individuals in the greater length of the brachials and of the cirrus segments, and in the more convex shape of the centrodorsal, only a small portion of which is free of cirri.

He noted that a few years after the publication of Dujardin and Hupé's monograph (1862) Dr. C. F. Lütken had given the name *Antedon braziliensis* to a type that had been obtained at Rio de Janeiro and has since proved to be very abundant on the Brazilian coast at the Abrolhos Islands and also at Bahia. Examples of it with Lütken's name attached were distributed to various museums. He said that it is now practically certain that Lütken's *Antedon braziliensis* and the form doubtfully referred by Verrill to *Antedon dübenii* are both identical with the species (*carinata*) from the Indian Ocean. He quoted the conclusions of Pourtalès and Rathbun and said that he was fortunately able in the autumn of 1880 to examine carefully the material in several continental museums from a considerable variety of localities. The results of this study led him to acquiesce in their conclusions, which were also adopted by Ludwig two years later.

Under the name *Antedon dübeni* Carpenter described a single specimen that had been dredged by the *Challenger* at Bahia. When he wrote this description he had before him, in addition to the *Challenger* specimen from Bahia, the type specimen of Böhlsche's *Antedon dübenii*, which is a true *Antedon* in the present restricted sense (see Part 5), and a few of the details in the description were taken from the latter (see page 299). He gave excellent figures of both specimens.

In a detailed account of the anatomy of crinoids published in 1889 Dr. Otto Hamann gave a minute description of the nervous system of *Antedon carinata* based upon material from Bahia that had been sent him by Carpenter, and in the same year Dr. F. A. Bather mentioned the 6-rayed "*Antedon*" recorded by Carpenter in 1888.

In a paper on a collection of crinoids from Madeira published in 1891 Carpenter said that the type specimen of *Antedon dübeni* was obtained at Rio de Janeiro, and another example (in reality a young *Tropiometra carinata*) was obtained by the *Challenger* at Bahia. He said he had much doubt as to *Antedon dübeni* being a good species, and added that the specimens of *A. dübeni* from Madeira (see Part 5) are unquestionably identical with those from Brazil, this being a point of some importance as it adds another to the species of crinoids which occur on both sides of the Atlantic.

In 1891 Dr. Clemens Hartlaub mentioned this species as one having an extraordinarily wide range, and included it in his list of species represented in the Göttingen Museum.

Prof. Percival de Loriol in 1893 published a detailed account of a collection of echinoderms that had been made by V. Robillard at Mauritius. In this collection there was a small number of dried specimens of *Tropiometra carinata*. Professor de Loriol said that these were sufficiently well preserved to admit of accurate identification, but that they furnished no additions to Carpenter's complete description. He added that a very perfect specimen collected at Rio de Janeiro failed to show any differences when compared with those from Mauritius.

In 1897 Prof. Hermann von Ihering recorded *Antedon brasiliensis* from the Ilha de Sao Sebastião in southern Brazil.

In his memoir on the echinoderms of the Zanzibar region published in 1899 Prof. Hubert Ludwig noted that this species had been recorded from Zanzibar by Pourtalès (1879) and Rathbun (1879), and from Madagascar and the Seychelles by P. H. Carpenter (1888).

Prof. Sir D'Arcy W. Thompson in 1900 and Dr. Frank Springer in 1901 cited this species as one having a very wide range.

In 1905 Dr. Wilhelm Minckert mentioned the commonly banded arms of *Antedon carinata* and remarked upon a specimen showing partial regeneration of a cirrus giving, however, no hint as to its origin.

In 1905 Prof. F. Jeffrey Bell described *Antedon capensis* as follows:

> This species appears to be allied to Carpenter's *A. basicurva*, but to differ from it and *A. incisa* by the larger number of cirrus-joints.
>
> The centrodorsal is flat, bare in the centre, with two rows of very stout cirri, as much or more than 25 mm. long. Arms very stout, but so broken that their length cannot often be guessed, somewhat flattened from side to side; an almost complete arm is figured; arm joints overlap, and are often provided with a median tooth, so that the arm, when viewed from the side, appears to have a dorsal keel; the pinnules which are stout and stiff, taper rather abruptly. The arms are beautifully spotted with purple.
>
> Most of this description will apply to a number of specimens, but there are very striking differences among them, some are very stout and strong, others are almost delicate; as the specimens have been in formalin and in spirit, too much importance is not to be ascribed to the absence of pigment, or to the difference to be seen in its distribution on the bodies of different examples.

He said that this new species appears to be allied to Carpenter's *Antedon* (=*Charitometra*) *basicurva* but to differ from *A.* (=*Charitometra*) *incisa* by the larger number of cirrus segments. He recorded specimens from five different stations.

Minckert in his treatise on regeneration published in 1905 mentions Carpenter's observations (1888) on a specimen from Mauritius and another from Bahia in which he "found a cirrus which shows signs of having been broken and subsequently repaired, the distal portion of it being much smaller than the base."

In my first revision of the old genus *Antedon* published in 1907 I made *Comatula carinata* Lamarck, 1816, the type of the new genus *Tropiometra*. In a footnote I gave Bell's *Antedon capensis* as a synonym of *Tropiometra carinata*, saying that I had compared specimens identified by Professor Bell with others from Zanzibar and had found them identical. This was written at the Museum of Comparative Zoology. Not long before, Dr. Hubert Lyman Clark had received from Professor Bell some cotypes of *Antedon capensis* and with his characteristic kindness had permitted me to examine them. Under the genus *Tropiometra* I listed *T. braziliensis* (Rathbun) as well as *T. carinata* (Lamarck).

In a paper published in January 1908, I discussed in detail 17 6-rayed specimens of *Tropiometra carinata* from Rio de Janeiro that I had found among the 348 specimens in the Museum of Comparative Zoology, and figured five of them. I said that Prof. F. Jeffrey Bell had been so kind as to examine for me the 6-rayed "*Antedon*" in the British Museum recorded by Carpenter in 1888 and subsequently mentioned by Bather and by Bateson and had identified it as *T. carinata*, but said there was no information regarding its origin. In a paper published on April 11, 1908, I said that in my paper revising the old genus *Antedon* published in the preceding year I had followed Carpenter in placing *Antedon dübeni* of Böhlsche near *Antedon bifida* in the genus *Antedon* as restricted, whereas it is merely the young of *Tropiometra carinata*. In a paper published on May 14, referring to the 6-rayed specimens from Rio de Janeiro, I spoke of the more or less normal multiradiate condition in *Tropiometra carinata*, and in another paper published on June 9 I remarked that *Tropiometra carinata*, constant in its characters from east Africa to Oceania, is extremely variable in Brazil. In a paper published on June 16 I mentioned the completely 6-rayed condition sometimes found in *Tropiometra carinata*, and in another paper published on July 15, in recording instances of regeneration of the cirri in *Tropiometra afra* (*macrodiscus*), I noted that regeneration of the cirri appears to be rare among the comatulids, having been reported previously only in *Tropiometra carinata* and, more recently, in *Decametrocrinus vanhöffenianus* (=*Promachocrinus kerguelensis*).

In a paper published on August 25, 1908, I wrote that there can be little doubt that *Alecto carinata* Leach, 1815, is the same species as *Comatula carinata* Lamarck, 1816, as was suggested by Lamarck himself. The description, however, is quite useless, and the type has been lost. We know what Lamarck's species really is. Therefore, we must date the name from Lamarck, 1816, with *Alecto carinata* Leach, 1815, as a questionable synonym. Regarding *Antedon capensis* I wrote that Professor Bell described this species in the *Basicurva* group, whereas it really belongs with *Comatula carinata* of Lamarck, placed by P. H. Carpenter in the *Milberti* group. I said that I had examined some of the original specimens and could not separate them from true *Comatula carinata* from Mauritius or Zanzibar. I added that *Comatula carinata* from East Africa varies very little, but specimens from the West Indies and Brazil are very variable, especially in regard to the carination of the arms. Six-rayed individuals also are common at the latter locality. Under *Antedon gorgonia* I wrote that it is difficult to see just why there has been so much confusion in regard to this species. Dr. P. H. Carpenter followed Lamarck in placing it with a query in the synonymy of *Comatula carinata* Lamarck, 1816, and said that the type of *Antedon* is a tropical species. It is wholly improbable that any *Antedon* could cling to the growth on a ship's bottom from the most northern point in the range of *Comatula carinata* all the way to Havre without getting swept off or killed by the violent wave action to which it would of necessity be subjected; moreover, it is extremely doubtful whether *Comatula carinata* from the littoral zone of the Tropics could survive the cold surface water of the ocean off the coast of France, even in summer. On the other hand, if there were any individuals of *Antedon bifida* living about the dock (and the old-fashioned dry dock is very attractive to marine organisms) it is quite probable that they would become disturbed by the commotion caused by an entering ship and swim about; and they would be as likely to settle on the ship's bottom as anywhere else. Therefore it seemed to me that there can be no doubt that the type of *Antedon gorgonia* came from Havre. The figure to which de Fréminville refers undoubtedly represents *Antedon bifida*. *Antedon gorgonia* was referred unconditionally to *Asterias bifida* by Bell in 1892, but he did not state his reasons for doing this at the time, nor has anything been published on the subject since. I added that as it is of considerable importance to have a definite type for the genus (*Antedon*) the preceding remarks may not be entirely superfluous. I also noted that Böhlsche's *Antedon dübenii* is the young of *Comatula carinata* Lamarck. In a paper published in December 1908, I discussed the coloration of this species, describing it as a mosaic with both a yellow and a red base.

Prof. F. Jeffrey Bell in 1909 recorded *Antedon carinata* from Saya de Malha in 300–500 fathoms; north reef, Farquhar atoll; Cargados Carajos in 30 fathoms; and the Seychelles in 15 fathoms. The specimens had been collected by the Percy Sladen Trust expedition in the *Sea Lark* under the direction of Prof. J. Stanley Gardiner. The record from Saya de Malha probably refers to some other species, as *Tropiometra carinata* in the Indian Ocean seems to be a strictly littoral form.

In a paper on the crinoids of the Copenhagen Museum published in 1909, under the heading *Tropiometra carinata* I said that specimens from South Africa, east Africa, the East Indies, and the south Pacific ocean are very uniform in their characters, and agree in having a moderate or slight carination of the brachials; on the coast of Brazil and in the West Indies the brachial carination is as a rule much stronger, and may be extravagantly developed and correlated with spinous distal ends to the pinnule and cirrus segments; but on the other hand specimens may readily be found quite as smooth as any from the Indian Ocean. This enormous range in the extent of carination is accompanied by meristic variation, for 6-rayed specimens are not at all unusual in Brazil. As a species introduced into a new locality, provided it survives, becomes as a rule much more variable than in its native habitat, it might well be argued that *Tropiometra carinata* is a comparatively new element in the west-central Atlantic fauna, not yet old enough to have, through elimination of the economically unfit, attained a definite varietal form, the more strongly since the only other species of the genus, and all the remaining genera of the family [as considered at that time] are restricted to the seas lying between northern Australia and southern Japan. I added that one feature of the distribution of this species is of considerably more than ordinary interest. In the Lesser Antilles it occurs between 200 and 300 fathoms instead of littorally and sublittorally, as throughout the remaining portions of its range. A similar phenomenon at Rockall has been taken as indicating that that ocean landmark has sunk within comparatively recent times, carrying down its echinoderm fauna with it. But the case in the West Indies is susceptible of a more satisfactory explanation. The Amazon and Orinoco Rivers interpose an insuperable barrier, insofar as the littoral crinoids are concerned, between the Brazilian coast and the Antilles. But an adaptable species, provided there were a suitable food supply, could surmount this barrier by the simple process of gradually increasing the depth of its habitat and thus passing under it, in water of a sufficient depth to insure a uniform salinity. Thus it is possible that *Tropiometra carinata* has extended its range northward from Brazil by passing under the fresh water discharged into the sea by the Amazon and Orinoco, and, having reached the Antilles, has not yet risen again to its normal littoral habitat. A species of Comasteridae, *Nemaster lineata* (=*N. rubiginosa*), the only other littoral comatulid found in Brazil, agrees with *Tropiometra carinata* in inhabiting deep water in the West Indies. In the same paper I recorded and gave notes upon a very fine specimen of *Tropiometra carinata* from Zanzibar. Under the same name I included a specimen from the East Indies (*encrinus*).

In a paper on the recent crinoids of the coasts of Africa published in 1911, I said that *Comatula carinata* was the first crinoid known from African waters and mentioned that Pourtalès in 1878 and Rathbun in 1879 had discussed at considerable length specimens of *Tropiometra carinata* from Zanzibar, comparing them with specimens of *T. picta* from the coast of Brazil. Bell's *Antedon capensis* was identified as *T. carinata*, and this species was said to be restricted to the southeastern coast from Mombasa to Capetown, including all the outlying islands, its representative on the west coast, including the islands of St. Helena and Ascension, being *T. picta*, a species also occurring in the West Indies. A synonymy of *Tropiometra carinata* was given, together with a list of the localities from which it is known, the bathymetrical range, and the types of bottom on which it is found. In the synonymy were included Dujardin and Hupé's *Comatula bicolor* and von Martens's *Actinometra solaris*, as well as Bell's *Antedon capensis*. In the previous year I had examined the specimen from the Seychelles in the Paris Museum labeled *Comatula bicolor* and a specimen from Madagascar in the Berlin Museum labeled *Actinometra solaris*. *Tropiometra picta* from St. Helena and the American side of the Atlantic and *T. encrinus* from the Red Sea and eastward were treated as species distinct from *T. carinata*. I listed *Tropiometra picta* as occurring in the region embracing the west coast and the outlying islands of St. Helena and Ascension, remarking that it also occurred in the West Indies. I said that, as far as I could see, specimens from St. Helena were specifically inseparable from others from the opposite coast of South America. Under the heading *Tropiometra picta* (Gay) I gave a synonymy including *Alecto carinata* Leach, with a query, *Antedon brasiliensis* (Lütken) of Verrill and Rathbun, *Antedon carinata* of Carpenter, in part, and *A. dübeni* of Carpenter, in part, excluding Böhlsche's type specimen, which I assigned to the genus *Antedon*. Gay's original description of *Comatula picta* was reproduced, and it was stated that Gay did not find the species in Chile himself but merely recorded in his work some specimens he had found in the Paris Museum labeled as from Chile while he was engaged in writing his history (see p. 322). I remarked that the coast of Chile has been carefully searched by zoologists over and over again, and no one who has been in that country ever mentioned the occurrence of crinoids (other than *Heliometra* [=*Florometra*]) from personal observation. Dr. Carlos Porter of Santiago assured me (in a personal interview in Paris) that they are never found there. "We must conclude, therefore, either that Valenciennes' specimens were wrongly labeled, or that some other Chile is meant." I said further that the *Antedon braziliensis* proposed, though not described, by Lütken, which is the same thing as Gay's *Comatula picta*, and which was subsequently compared in considerable detail with Lamarck's *Comatula carinata*, by Rathbun, has never been recognized; it is a perfectly good species, however, as I had recently been able to assure myself, most obviously differing from *carinata* in the greater length of the outer cirrus segments.

In a paper on the crinoids of the Paris Museum published in 1911, I recorded under the name *Tropiometra picta* (Gay) 11 specimens labeled "Chili; M. Gay, 1829." I wrote: "Cette espèce était appelée *Brasiliensis* par Lütken, et était décrite sous ce nom par Rathbun en 1879." I listed a specimen without locality collected by M Cloué in 1847, eight specimens from Mauritius, two from Zanzibar, and one from the Seychelles collected by L. Rousseau in 1841 and labeled *Comatula bicolor*. Presumably this label was the original of the museum name *Comatula bicolor* listed by Dujardin and Hupé in 1862. In a paper on the crinoids of the Leyden Museum published in 1911 I compared a specimen of a species of *Tropiometra* labeled "Indian Ocean" with *T. carinata*, of which I said that the cirri are distinguished by their very short segments. I also compared it with *T. picta*. In my memoir on the Recent crinoids of Australia published in 1911, I inserted *encrinus* in the key to the Australian species of the genus *Tropiometra*, giving Queensland as the locality, and later said of *T. encrinus* that there are no definite Australian records, but that I had examined a number of specimens labeled "South Pacific" that possibly came from Australia. The specimens labeled "South Pacific" and assumed to be *T. encrinus* came in reality from Rio de Janeiro and represent *T. carinata* (see p. 319). A specimen of *T. afra* with the same label is presumably from Queensland, and this gave rise to the confusion. In describing a 7-rayed specimen of *Dichrometra tenera* (=*Lamprometra gyges*) from Perth, Western Australia, in 1911 I said that it is not uncommon to find specimens of *Tropiometra picta* (=*carinata*) from Rio de Janeiro with six rays.

Dr. August Reichensperger in 1912 mentioned the cases of partial regeneration of the cirri in *Antedon carinata* recorded by Carpenter and Minckert, and said that, as far as he knew, this was the only species in which it had been reported.

Hartlaub in his memoir on the *Blake* comatulids published in 1912 listed *Antedon carinata* as among the species sent him with the *Blake* collection, though it was not taken by that ship. He said that this species has an enormous range, being found near St. Lucia in the Caribbean Sea, in the Atlantic and Indian Oceans, and also on the Pacific coast of South America. Under the heading *Antedon carinata* he gave a detailed synonymy, and listed 16 specimens in the material submitted to him. These were: (1) Three medium sized specimens with the indefinite locality Fiji (?), Kingsmills (?) [in reality from Rio de Janeiro; see p. 319]; (2) four larger and one smaller specimens from Zanzibar, C. Cooke, Edw. Rosses, Cheney Webb, collectors, 1862, 1868 (M. C. Z. 20); (3) one medium sized specimen from off the Abrolhos, Brazil, in 30 fathoms, *Hassler* expedition, January 20, 1872; (4) seven specimens, one large, two of medium size, and four small, from St. Lucia (lat. 13°52′ N., long. 61°07′ W.), taken by the cable repair ship *Investigator*, Capt. E. Cole, in 1879. He described these specimens in great detail. He noted that a specimen from ?Fiji had a cirrus showing partial regeneration. This was the specimen recorded by Minckert in 1905 without any indication as to its origin. Hartlaub concluded his account of this species with a notice of the author's remarks on the 6-rayed specimens from Rio de Janeiro.

In a paper on the crinoids of the Hamburg Museum published in 1912, I recorded two dry specimens of *Tropiometra carinata* from Mauritius, and 29 specimens of *T. picta* from four localities along the Brazilian coast, together with two without locality. In a paper on the crinoids of the Berlin Museum published in the same year I recorded a specimen of *Tropiometra carinata* from Madagascar that bore the label "*Actinometra solaris*," one from Zanzibar collected by Count von der Decken, and four lots including 28 specimens from Mauritius, giving notes on the last. I also recorded and gave notes on 41 specimens from Brazil, 39 of which were from Rio de Janeiro, one of these having 11 arms. In my memoir on the crinoids of the Indian Ocean published late in 1912 I said that in 1815 Dr. William Elford Leach had described *Alecto carinata*, which is supposed to be the *Comatula carinata* of Lamarck, and which may have come from India. I gave all the previous records for *carinata* (under various generic names) from the Indian Ocean region, and the correct determination of the specimens upon which they were based. A synonymy of *Tropiometra carinata* was given, including ?*Alecto carinata* Leach, *Comatula bicolor* Dujardin and Hupé, *Actinometra solaris* von Martens, and *Antedon capensis* Bell. The habitat was given as southern and southeastern Africa, including Madagascar, Mauritius, the Seychelles, Réunion, the Mascarene Islands, Saya de Malha, Cargados Carajos, Farquhar Atoll, and Zanzibar. The bathymetrical range was given as littoral and down to 30 fathoms. I noted that *Antedon carinata* as understood by Carpenter in the *Challenger* report (1888) was made up of *Tropiometra carinata*, *T. encrinus*, and *T. picta*. I said that although the genus *Tropiometra* is almost everywhere confined to very shallow water, in the Lesser Antilles the local species (*T. picta*) is found only at very considerable depths, and, as the same is true of another widely different littoral species in the same region (*Nemaster lineata* [=*N. rubiginosa*]) we seem to have evidence suggesting that those islands have gradually subsided, carrying these two littoral species down to a level which, though once the coast line, is now more than 100 fathoms beneath the surface.

In a paper on the crinoids of the British Museum published in 1913, I recorded two specimens of *Tropiometra carinata* from Mauritius, seven from Zanzibar, and 38 from 11 localities in South Africa, these last having previously been determined as *Antedon capensis* by Prof. F. Jeffrey Bell. I also recorded five lots of specimens of *Tropiometra picta* from Brazil, one from St. Helena, and two without locality. In my account of the crinoids of west Africa published in 1914 I said that *Tropiometra carinata* occurs in South Africa and northward to Zanzibar, and also about Madagascar and the Seychelles, and generally among the islands of the southwestern Indian Ocean. I said that another species, *T. picta*, occurs at St. Helena and along the American coast from St. Lucia in the West Indies and Venezuela southward to Santa Catharina Island in southern Brazil. In 1915 in my memoir on the crinoids of the Antarctic I recorded and gave notes on a small immature specimen of *Tropiometra carinata* from Simons Bay and compared it with the young specimen from Bahia that had been described and figured by Carpenter under the name *Antedon dübeni*. I said that *T. carinata* occurs from Simonstown, False Bay, eastward and northward to Zanzibar, and further eastward to Madagascar, Farquhar Island, the Seychelles, Saya de Malha, Cargados Carajos, and Mauritius, in 0–54 meters (0–30 fathoms).

In 1916 Dr. Hubert Lyman Clark published a preliminary notice of a detailed study of the habits and reactions of *Tropiometra carinata* which he had found living in shallow water in Buccoo Bay, Tobago, where it was common and easily accessible, in the spring of the same year. At the same time Dr. Th. Mortensen made extensive studies on the development of various echinoderms, including the same species. In 1917 Dr. Clark described the habits and reactions of *T. carinata* in detail. He said that comparison between the comatulids taken at Tobago and a considerable series of specimens from several stations on the Brazilian coast south of the Amazon shows that they are unquestionably identical. He noted that for this Brazilian species I had revived an old name of Gay's, *picta*, regarding it as "a perfectly good species," "most obviously differing from *carinata* in the greater length of the outer cirrus segments." He said that on comparing the Brazilian and Tobagoan material with specimens from Mauritius and Zanzibar he was utterly unable to detect any differences, either in the cirri or in any other characters. He recorded that on writing me concerning his difficulties I had replied that while the species of *Tropiometra* are very difficult to distinguish, I found "no difficulty in distinguishing" the group in which I placed *picta* from that in which I placed *carinata* "by the difference in length of the outer cirrus segments." On receipt of this letter he again went over the cirri, but found himself absolutely unable to detect the difference named. He said he had therefore very reluctantly reached the conclusion that he could not recognize *picta* as a valid species, but must designate his Tobagoan comatulids by the old Lamarckian name—*carinata.*

In my report on the crinoids of the *Siboga* expedition published in 1918, I included a key to the species of the genus *Tropiometra.* In this key *T. carinata* was given as occurring in southern and southeastern Africa and among the islands in the southwestern Indian Ocean, and *T. picta* was said to range from Venezuela and the southern Caribbean Sea southward to southern Brazil. In the key *carinata* is given under the heading "cirrus segments very short, more than twice as broad as long," and *picta* under the heading "cirrus segments longer, in the outer half or two thirds of the cirri much less than twice as broad as long."

In his memoir on the littoral echinoderms of the West Indies published in 1919 Dr. H. L. Clark said that at Tobago he found a comatulid, *Tropiometra carinata,* common in very shallow water in Buccoo Bay and on Buccoo reef. He remarked that this is a species of wide distribution on the coasts of southern Africa and Brazil and reaches its northern limit in deep water (200–300 fathoms) off St. Lucia. As a littoral species its northern limit seems to be at Tobago.

In 1920 Dr. Th. Mortensen published in detail the results of his studies on the early stages of *Tropiometra carinata* carried on at Tobago in March and April, 1916. This memoir was reviewed at considerable length by Dr. F. A. Bather in 1921.

In my memoir on the crinoids collected by the Barbados-Antigua expedition of the University of Iowa published in 1921, I mentioned, as an illustration of the paucity of the data regarding the crinoids from very shallow water in the western Atlantic, that, except for *Tropiometra picta,* which is locally abundant from Tobago, Trinidad, and Venezuela to southern Brazil, there are only six records. In a general account of the Recent crinoids published in 1921, I quoted Dr. H. L. Clark's observations on the stomach contents of *Tropiometra picta* at Tobago.

In a memoir on the echinoderm fauna of South Africa published in May 1923, Dr. Hubert Lyman Clark recorded two specimens of *Tropiometra carinata* from Mozambique, one from Delagoa Bay, and one from off the Itongazi river, Natal, in 25 fathoms, giving notes on the first mentioned. He said:

> The distribution of this species is of considerable interest. It ranges from the Seychelles, Reunion, Mauritius and Zanzibar southward to the Cape of Good Hope and thence northwestward to St. Helena, Brazil and the southernmost West Indies. It is true that Mr. A. H. Clark considers the specimens from the latter regions specifically distinct from those taken on the east coast of Africa, but a prolonged comparison of specimens from Tobago, B. W. I., with individuals of the same size from Zanzibar has satisfied me that the supposed differences do not exist.

In my memoir on the crinoids collected by the *Ingolf* published in 1923, I listed two species of *Tropiometra* from the Atlantic. One of these, *T. picta,* was said to range from Venezuela, Trinidad, Tobago, and St. Lucia southward to Santa Catharina Island, Brazil (lat. 27°30′ S.), and St. Helena, in 0–508 meters. The other, *T. carinata,* was said to occur from Simon's Bay, Cape of Good Hope, to Zanzibar, Madagascar, the Seychelles, Saya de Malha, Cargados Carajos, and Mauritius, in 0–55 meters.

In 1924 Dr. Torsen Gislén mentioned the sluggishness and inactivity of this species as described by Dr. H. L. Clark. In 1928 Gislén published notes on the small specimen from the *Challenger* collection that had been recorded as *Antedon dübenii* by Dr. P. H. Carpenter.

In a paper on a collection of crinoids from the Indian Ocean and the Bay of Bengal published in 1932, I listed all the localities from which *Tropiometra carinata* is known.

In 1933 Dr. Torsten Gislén recorded and gave notes on 18 specimens of *Tropiometra carinata* that had been collected by Dr. Th. Mortensen at St. Helena. He made detailed comparisons between specimens of *T. carinata* from Zanzibar and Portuguese East Africa and others from St. Helena and from Tobago (the last collected by Mortensen), and he compared both with specimens in the Copenhagen Museum that had been determined as *T. encrinus* by the author. He figured cirri from specimens from Tobago, St. Helena, and Portuguese East Africa. He said he must confess that he failed to find any differences in regard to the proportions of the cirrus segments, and as the carination of the arms in specimens from the West Indies and from East Africa seemed to him identical, he was forced to regard *T. picta* as a synonym of *T. carinata*. He remarked that the specimens from St. Helena usually have a slightly greater number of cirri than examples from other localities, but said that he could not regard this difference as even a varietal character. The cirrus segments are also a little more numerous in the specimens from St. Helena (24–27, or even 29); but he recalled that I mentioned a specimen of *T. carinata* from South Africa with 28 cirrus segments. He regarded *T. encrinus*, however, as a valid form. In 1938 Gislén recorded *Tropiometra carinata* from *Pieter Faure* stations 2001 and 2012, and under the name *Tropiometra clarki* described in detail a specimen from Mortensen's station 66 in False Bay.

TROPIOMETRA CARINATA INDICA A. H. Clark

[See vol. 1, pt. 1, fig. 265 (ventral view of centrodorsal), p. 257.]

Antedon carinata Bell, Sci. Trans. Roy. Dublin Soc., ser. 2, vol. 3, 1887, p. 645 (Ceylon); Proc. Zool. Soc. London, 1888, p. 387 (Bay of Bengal [=Ceylon]).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 200, 202 (Ceylon).—Chadwick, Report Ceylon Pearl Oyster Fisheries, pt. 2, Suppl. Report 11, 1904, p. 153 (occurs at Ceylon), p. 154 (stations LIV, LXVIII).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 374 (Ceylon).

Antedon adeonae Bell, Sci. Trans. Roy. Dublin Soc., ser. 2, vol. 3, 1887, p. 645 (Ceylon); Proc. Zool. Soc. London, 1888, p. 387 (Ceylon; Tuticorin, Madras).

Tropiometra carinata (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (included under this name up to 1911).

Tropiometra sp. A. H. Clark, Notes Leyden Mus., vol. 33, 1911, p. 189 (Indian Ocean; notes).

Tropiometra encrinus (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 36 (Ceylon); Crinoids of the Indian Ocean, 1912, p. 177 (Galle, Ceylon; ?India; characters; Indian Ocean).—Reichensperger, Abh. Senck. naturf. Ges., vol. 35, No. 1, 1913, p. 106 (Ceylon; detailed discussion; considered identical with *carinata*).

Tropiometra indica A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity), pp. 401, 402 (characters; comparison with *T. audouini*; Ceylon and adjacent parts of India); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 39 (published references to specimens in the B. M.; Ceylon; Tuticorin, Madras; characters); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 313 (range; Ceylon and the adjacent portions of southern

India).—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 85 (Ceylon; detailed description of a specimen), p. 93 (occurs at Ceylon).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 131 (in key; range).—Gislén, Ark. Zool., vol. 19, No. 32, 1928, p. 6, No. 22 (notes on specimens in the B. M.).—A. H. Clark, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 551 (listed), p. 560 (Neendakara Bar; notes), p. 564 (range); John Murray Exped. 1933–24, Sci. Reports, vol. 4, No. 4, 1936, p. 105.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, 1938, p. 17 (discussion).

Diagnostic features.—The carination of the arms is continued to the tips and varies from slight to well marked; the cirri are XVI–XXXVIII (averaging XXV), 20–26 (usually 20–22), from 15 to 22 (averaging 18) mm. long; the proximal pinnules are often more or less stiffened, but are not spine-tipped.

This form is very close to true *carinata,* but as a rule there is no difficulty in identifying specimens. It is closer to *carinata* than it is to the geographically nearer *clarki.*

Notes.—In the specimen from the Neendakara Bar the centrodorsal is thick discoidal with the broad flat dorsal pole about 5 mm. in diameter. The cirri are XXXVIII, 22–25, about 20 mm. long. The cirrus segments are subequal, usually about twice as broad as long, those in the outer third of the cirri being usually very slightly broader than those in the proximal half. The arms are about 100 mm. long. The carination of the brachials is slight, but when the specimen is dry it is easily made out in the proximal half of the arms. In the distal half of the arms it gradually becomes more and more obscure, and in the terminal fourth of the arms there may be no trace of carination, the brachials having an evenly rounded dorsal surface and slightly produced and finely spinous distal ends.

The 17 specimens from Galle, Ceylon, are all small or of medium size.

In a lot of 14 specimens from Ceylon in the British Museum the cirri are XXVI–XXIX, 23–26 (usually 25), 21 or 22 mm. long. The outer cirrus segments are about twice as broad as long as in *T. carinata.* The last four segments taper rather rapidly. The cirri are rather slender and weak, but very numerous, giving the animal a very characteristic appearance. They are arranged very irregularly, approximately in two and a partial third rows on the centrodorsal. The proximal pinnules are stiffened.

Eleven specimens from Ceylon studied by Dr. August Reichensperger showed the following characters:

1. The cirri are XXV, 20, 17 mm. long. The arms are 75 mm. long. The carination of the brachials is slight. The pinnules are slightly stiffened.
2. The cirri are XXI, 20, 16 mm. long. The arms are 70 mm. long. The carination of the brachials is slight. The pinnules are stiffer than in the preceding specimen.
3. The cirri are XXIV, 21, 18 mm. long. The arms are 80 mm. long. The carination of the brachials is medium. The pinnules are stiffer than in the first.
4. The cirri are XX, 22, 17 mm. long. The arms are 85 mm. long. The carination of the brachials is medium. The pinnules are stiff.
5. The cirri are XVI, 20, 15 mm. long. The arms are 85 mm. long. The carination of the brachials is strong. The pinnules are stiff.
6. The cirri are XXX, 22, 20 mm. long. The arms are 100 mm. long. The carination of the brachials is strong. The pinnules are moderately stiff.

7. The cirri are XXXII, 21, 20 mm. long. The arms are 105 mm. long. The carination of the brachials is medium. The pinnules are moderately stiff.

8. The cirri are XXIV, 21, 16 mm. long. The arms are 90 mm. long. The carination of the brachials is medium. The pinnules are moderately stiff.

9. The cirri are XXVI, 20, 19 mm. long. The arms are 105 mm. long. The carination of the brachials is slight. The pinnules are stiff.

10. The cirri are XXII, 22, 18 mm. long. The arms are 75 mm. long. The carination of the brachials is slight. The pinnules are stiff.

11. The cirri are XXIV, 20, 16 mm. long. The arms are 80 mm. long. The carination of the brachials is slight. The pinnules are only slightly stiffened.

Of these specimens four lack any suggestion of a third row of cirri on the centrodorsal. The color in alcohol is mostly darker or lighter purple red brown with yellow spots along the sides of the arms, or dark purple without spots. Two specimens are entirely light brownish.

The specimen from Ceylon in the Colombo Museum has the cirri XXV, 22–23, about 20 mm. long. The middle and distal segments are 1 mm. long, 1 mm. broad, and from 1.5 to 1.75 mm. thick. The centrodorsal is thick and discoidal, 7–8 mm. across, with the cirri arranged in one and a partial second marginal row. The arms are stout at the base, rather abruptly attenuate from near the middle, probably about 60 mm. long, but none is complete. The brachials are very low, less than 1 mm. long, even when the distal margin measures 4.5 mm. Near the base of the arm there are 14 brachials (including two syzygial elements) in 10 mm.; beyond the middle there are 18 or 19 brachials (including two syzygial elements) to 10 mm. The distal margin of the basal brachials is very uneven and irregular, slightly flaring, and not at all serrate or spiny. There are at least three evident projections, the largest near the base of the pinnule but separated from it by a reentrant curve, the smallest on the other side of the brachial, and the third median in position. This third projection becomes increasingly conspicuous on each succeeding brachial, until at the middle of the arm it is a rough projecting knot or rounded tooth. Distally it gradually decreases in size and disappears. The pinnules are much as in *T. encrinus* [=*clarki*], but the two basal segments of the middle pinnules are conspicuously larger than the segments succeeding, and rather abruptly so. These two segments are much broader than long. The color is light brownish white without markings of any sort.

Dr. Hubert Lyman Clark, whose notes are quoted above, said that comparison between this specimen and typical specimens of *carinata* and *encrinus* [=*clarki*] shows that it is neither of those species. Nor does it seem to be any nearer *indica*, so far as the author's fragmentary references to that species show; but as the author examined the specimen and assured him that it was *indica* he refrained from giving it another name. But he decided to let the description he had drawn up stand. There are no data with the specimen.

In the specimen from the "Indian Ocean" in the Leyden Museum the cirri are XV, 18–22, comparatively weak and slender; the cirrus segments are all subequal, all slightly broader than long, the last four tapering slightly; the brachial carination is moderate. It appears to belong to this form.

Localities.—Neendakara Bar, Travancore State; Drs. H. S. Rao and M. Sharif, February 1928 [A. H. Clark, 1932] (1, I. M.).

Tuticorin, Madras Presidency [Bell, 1888; A. H. Clark, 1912, 1913, 1914] (1, B. M.).

Ceylon Pearl Oyster Fisheries station LIV; Gulf of Manaar; in the northern part of the Gulf of Manaar, south of Adams Bridge; 7–73 meters; bottom varied, from sand to living coral [Chadwick, 1904].

Ceylon Pearl Oyster Fisheries station LXVIII; west coast of Ceylon; from off Coppeluddi southward to Navakaddu Paar; 15–34 meters; bottom nullipores (*Lithothamnion fruiticulosum*), coral, and Orbitolites sand [Chadwick, 1904].

Galle, southwestern Ceylon [A. H. Clark, 1912] (17, U.S.N.M., 35418 [original No. 25D], 35419 [original No. 18D], 35422 [original No. 2D], 35423 [original No. 20D], 35425 [original No. 28D], 35427 [original No. 16D], 35428 [original No. 31D], 36257; I. M.).

Ceylon [Bell, 1887, 1888; P. H. Carpenter, 1888; de Loriol, 1893; Hartlaub, 1912; A. H. Clark, 1911, 1912, 1913, 1914] (14, B. M.).

Ceylon [Bell, 1888; P. H. Carpenter, 1888; de Loriol, 1893; Hartlaub, 1912; A. H. Clark, 1911, 1912, 1913, 1914] (3, B. M.).

Ceylon; Doctor Sarasin [Reichensperger, 1913].

Ceylon [H. L. Clark, 1915] (1, Colombo Mus.).

Indian Ocean [A. H. Clark, 1911] (1, L. M.).

Geographical range.—Coast of Travancore State, southwestern India, the Gulf of Manaar, and the western and southwestern coasts of Ceylon.

Bathymetric range.—From the shore line down to 15 (?73) meters.

History.—This form was first mentioned by Prof. F. Jeffrey Bell, who in 1887 recorded specimens from Ceylon as *Antedon carinata* and also under the name of *A. adeonae.* In 1888 he recorded *Antedon adeonae* from Ceylon and from Tuticorin in the Madras Presidency of India; his mention of *Antedon carinata* from the Bay of Bengal is based upon specimens of *Tropiometra indica* from Ceylon, but this species is not known to occur on the eastern side of the island.

In the *Challenger* report upon the comatulids published in 1888 Dr. P. H. Carpenter included specimens of this form from Ceylon under the name *Antedon carinata.*

In his report on the Crinoidea collected by Professor Sir William Herdman in connection with the pearl oyster fisheries investigations in Ceylon in 1902, which was published in 1904, Herbert Clifton Chadwick recorded one specimen from station LIV and several from station LXVIII on the west coast of Ceylon and in the Gulf of Manaar under the name of *Antedon carinata.*

In my first revision of the old genus *Antedon* published in 1907, I included this form in *Tropiometra carinata* as understood by me. In my memoir on the Recent crinoids of the coasts of Africa published in 1911, I included this form under a new species, *Tropiometra encrinus* (see p. 333), which I said appeared to be generally rare, though common about Ceylon. In my paper on the crinoids of the Leyden Museum published in 1911, I recorded a specimen of *Tropiometra* sp., from the "Indian Ocean" and gave notes on it. I said that the brachial carination is moderate as in the "South Pacific" specimens (=*carinata;* see page 319). I added that this specimen appears to belong to an undescribed species which occurs westward from the Indian Ocean to the South Sea Islands; it is characterized by having the cirri small and weak, though otherwise as in *T. picta* (=*carinata*) of the West Indies and Brazil. The cirri of the two other Indian Ocean species, *T. carinata* and *T. encrinus* (=*clarki*), are stout and large, especially in the first named, which has the largest cirri of any of the smaller species of the genus; the cirri of *T. carinata* are easily distinguished by their very short segments. I said that as yet I had not been able to examine a sufficient number of specimens of this animal to justify me in bestowing upon it a new specific name. I noted that East Indian specimens of species of this genus appear to be very rare.

Hartlaub in 1912 included Ceylon among the localities for *Antedon carinata*, taking his information from Carpenter, 1888.

In a paper on the crinoids of the Berlin Museum published in 1912, I said that *Tropiometra encrinus* as understood by me in 1911 is in reality a composite including three species, *Tropiometra encrinus*, *T. audouini*, new species, and *T. indica*, new species. Under the heading *Tropiometra audouini* I said that this new form is nearest to *T. indica* from Ceylon and gave a brief summary of the characters of the latter, saying that I had examined 48 specimens, all from Ceylon or adjacent parts of India. In my memoir on the crinoids of the Indian Ocean published in 1912, I included under *Tropiometra encrinus* specimens from the Red Sea, Ceylon, and eastward. I recorded 17 small or medium-sized specimens from Ceylon and gave a summary of the characters presented by a series of specimens from Ceylon that I had examined at the British Museum in 1910. In a paper on the crinoids of the British Museum published in 1913, under *Tropiometra indica*, I gave a brief description of 14 specimens from Ceylon that had originally been recorded by Professor Bell as *Antedon adeonae*, and listed three others from Ceylon and one from Tuticorin.

Dr. August Reichensperger in 1913 examined carefully the status of *Tropiometra encrinus* as given in my paper on the crinoids of the coasts of Africa and in my memoir on the crinoids of the Indian Ocean. He said that it seemed to him very questionable whether *encrinus* could be regarded as a species distinct from *carinata*; at the most it might be possible to maintain it as a geographical variety. He said that the limits of their ranges interdigitate, and recalled that I restricted *T. carinata* to the east and south African region, saying that *T. encrinus* occurs from Aden to the East Indies and farther eastward, and is especially common at Ceylon. He noted that I (1911) based *T. encrinus* exclusively on the form of the cirri and of the cirrus segments and that little of a definite nature can be deduced from my statements. The single differential character that is to a certain extent valid in separating *carinata* from *encrinus* is that *encrinus* sometimes has three rows of cirri; but this character does not always hold, as is shown by his specimens (from Ceylon). Just as little is to be gathered from the carination of the arms or the stiffness of the lower pinnules. He said that in 1909 I was of his opinion when I wrote "specimens from South Africa, east Africa, the East Indies and the South Pacific are very uniform in their characters, and agree in having a moderate or slight carination of the brachials." At the same time, he recalled, I wrote that in specimens from Brazil and the West Indies the brachial carination as a rule is stronger, and it may be exceptionally strong, in which case the ends of the pinnule and cirrus segments are spiny; but on the other hand specimens may readily be found quite as smooth as any from the Indian Ocean. Of Reichensperger's 11 specimens from Ceylon four showed no indication of a third row of cirri. The number of cirrus segments was most constant, 20–22; but the relation of length to breadth is not always the same as is seen by a comparison of the number of segments with the cirrus length. In Reichensperger's opinion Carpenter was quite right in not separating these forms, which appear to be inextricably interconnected through an infinite number of intergrades. The transitional forms, which are much more numerous than the extreme or typical forms, prove that *T. carinata* is to be regarded in the sense of Pourtalès, Carpenter, and others, as a single specific type of which the enormous geographical range with varying living conditions leads to the formation of varieties and races which in no respect lose their specific characteristics, these at the most becoming modified in very slight degree. Reichensperger concluded that the attempt to carry out specific division within the *carinata* type would lead not to an elucidation of, but to obscuring, the mutual interrelationships within this interesting group.

In my paper on the crinoids of west Africa published in 1914, I listed *Tropiometra indica*, saying that it occurred at Ceylon and in the adjacent portions of southern India.

In 1915 Dr. Hubert Lyman Clark recorded and described as *Tropiometra indica* a specimen from Ceylon. He had at first regarded this specimen as a representative of a new species, but at my suggestion, he decided to record it as *indica*.

In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918, I included *indica* in the key to the species of the genus *Tropiometra*, giving as the range Ceylon and southern India and eastward to Oceania. In a paper on a collection of crinoids from the Indian Ocean and the Bay of Bengal published in December 1932, I gave *Tropiometra indica* as occurring at Ceylon (Gulf of Manaar and western coasts), Tuticorin, Madras Presidency, India, and Neendakara Bar, Travancore State, India. A specimen from the last-mentioned locality was recorded and described.

TROPIOMETRA CARINATA AUDOUINI A. H. Clark

Plate 35, Figures 185, 186; Plate 39, Figure 202

[*Comotula* sp.] Audouin, *in* Savigny, Description de l'Egypte, 1817, 1826, p. 205, Echinodèrmes, pl. 1, figs. 2.1, 2.2, 2.3 (disk; cirrus; part of an arm).—A. H. Clark, Amer. Nat., vol. 43, 1909, p. 254 (identified as *T. carinata* [*audouini*]); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 1 (identified as *T. encrinus* [*audouini*]); Crinoids of the Indian Ocean, 1912, p. 2 (same).

Comatula carinata (part) von Martens, Von der Decken's Reise in Ost-Africa, vol. 3, 1869, p. 129 (Red Sea).

Antedon sp. Moseley, Quart. Journ. Micr. Sci., vol. 17, 1877, p. 8 (Suez; coloring matter).—MacMunn, Quart. Journ. Micr. Sci., vol. 30, 1890, p. 55 (coloring matter; from Moseley).—Newbigin, Colour in nature, 1898, p. 135 (color).

Antedon carinata (part) P. H. Carpenter, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 157 (Red Sea and Aden); *Challenger* Reports, Zoology, vol. 26, part 60, 1888, pp. 200, 203 (Red Sea; Aden; Muscat; characters).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 374 (Red Sea; Muscat; discussion).

Tropiometra carinata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 349 (in part); Amer. Nat., vol. 43, 1909, p. 254 (known from the Red Sea since 1817), p. 255 (not reported by Chadwick).

Tropiometra encrinus (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 1 (identification of Audouin's record), p. 9 (northeastern coast of Africa), p. 36 (Red Sea; Aden; Suez); Crinoids of the Indian Ocean, 1912, p. 2 (identification of Audouin's record), p. 177 (Muscat; Aden; Tor, Red Sea; Red Sea; Suez).

Tropiometra audouini A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity), p. 401 (detailed description; Eig Tor, Gulf of Suez; Ras-el-Millan, Gulf of Suez; Aden; comparisons with other species); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 313 (range; Red Sea).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (Erg [not Eig] Tor; No. 5602 [type]).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 131 (in key; range); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 646 (Hurghada; notes); Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 564 (range); John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 87 (listed), p. 92 (*Mabahiss* station 53; notes; range), pp. 101, 104, 105.—Mortensen, Kongel. Danske Vid. Selsk. Skrifter, nat. math., Afd. 9 Raekke, vol. 7, No. 1, 1937, p. 7 (listed), p. 61 (description of larvae), pl. 14, figs. 1, 2.

Diagnostic features.—The brachial carination, which is only moderately developed, extends to the arm tips; the cirri are XVI–XXIII, 16–18, 13 mm. long; the arms are 50–80 mm. long; the proximal pinnules are stiff and spine-tipped.

Notes.—In the specimen from Ras-el-Millan the cirri are XXIII, 16–17, 13 mm. long. Many of the cirri are small, from 9 mm. with 14 segments upward. These all appear to be juvenile cirri which will be lost before maturity is reached. The arms are about 50 mm. long. The lower pinnules have sharp tips.

In the specimen from Erg Tor the centrodorsal is thick discoidal with a single marginal row of cirrus sockets.

The cirri are XVI, the only one remaining having 18 segments and being 13 mm. long. The outer cirrus segments are about half again as broad as long.

The arms are about 80 mm. long. The carination on the brachials is moderately developed.

The lower pinnules are very stiff, especially P_2, P_3, and P_4. P_1 is 7 mm. long with 16 segments. P_2 is 7 mm. long with 14 segments, and is stouter basally than P_1. P_3 is 6.5 mm. long with 16 segments. P_4 is 6 mm. long with 16 segments. P_2, P_3, and P_4 sometimes have spinelike tips resembling those of the proximal pinnules of the species of *Stephanometra*, and are very stiff. P_1 is also more or less stiffened. P_5 is 6.5 mm. long with 20 segments, slender, delicate, and distally flagellate, not stiffened like the pinnules preceding. P_6 resembles P_5. The distal pinnules are very slender.

The specimen from Aden is rather small.

The brachial carination in this species differs from that in *T. indica* in being broader, more rounded, and less sharp, and it is also fringed with coarser spines on its distal border.

Carpenter said that in the few specimens that he had seen from Muscat and from the Red Sea the indication of the middorsal line on the lower brachials from the second onward and the synarthrial tubercles are considerably less distinct than in "those from the Indian Ocean, Brazil, or the Caribbean Sea"—that is, than in the other forms; while in specimens from the Red Sea the terminal portions of the arms, as in the African variety (*carinata*) have stiffer pinnules and a less feathery appearance than is the case in Brazilian specimens.

Larvae.—Dr. Mortensen wrote:

> This comatulid, which occurs in good numbers on the reefs close to the station [Marine Biological Station of the University of Egypt, at Ghardaqa on the Red Sea coast, a little south of the Gulf of Suez], mainly on the under side of old loose coral blocks, was found ripe by the end of April. Some specimens were put into a large dish on the 18th and the next morning a good number of eggs were found lying on the bottom of the dish. The egg membrane is spiny as in *Tropiometra carinata.* About 24 hours old the embryos were partly free swimming, and on the next day there were some

hundreds of normal larvae, with ciliated bands and vestibulary invagination. A number of embryos were still enclosed within the egg membrane; it seemed clear that they had considerable difficulty in getting out of the shell in the still water in the dish, as I have formerly found it to be in the case with *Antedon petasus.* I then put these embryos into a plankton net in the tank, under the tap, so as to have them in constant movement in the water, and in this way I succeeded in getting another good lot of free-swimming embryos.

All the embryos were then put into some dishes with the bottom covered by small pieces of broken shells and corals, to which I hoped to see them attach themselves. Not till the 25th, thus after 5–6 days free-swimming, did I find a few of them attached and having assumed the Pentacrinoid shape, all the rest of the larvae still swimming, and no more of them did attach themselves. In the course of the following five days a few larvae tried to attach themselves to the bottom of the dish, but without success, and in 2–3 days more all of them had disappeared. Evidently the difficulty with these Crinoid larvae is to find suitable objects for them to attach themselves to, as I found to be the case with *Tropiometra carinata.*

Having already studied the embryological development of *Tropiometra carinata* in detail, I did not preserve any of the larvae for sectioning, wanting to have as much material as possible for eventually studying the further postembryonal development of the Pentacrinoids. I expected that by means of the various cultures of food organisms that I had at disposal it would be easy enough to keep the Pentacrinoids growing in the dishes. Unfortunately, this did not prove successful. Repeated attempts to get new cultures of the larvae failed; evidently the breeding season had passed—at least no more eggs were got. Thus the information I can give of the development of this *Tropiometra* is confined to the above statements, and to the figures of the young Pentacrinoid.

This Pentacrinoid has much resemblance with that of *Tropiometra carinata.* The oralia have no outturned edge such as is found in the Pentacrinoids of the Antedonids. There are three well developed infrabasals. The anal plate has appeared, but there is no trace of the radial and neither have I found the spicules of the tentacles or the first sacculus in any of the Pentacrinoids, though kept alive till the age of three weeks. It may, however, be mentioned that as in *Tropiometra carinata* I have found in one specimen a small, young plate lying some distance out in the primary tentacle. It may be suggested that it is the first axillary; but in the absence of further development stages this remains a little uncertain.

Localities.—Suez [Moseley, 1877; MacMunn, 1890; Newbigin, 1898; A. H. Clark, 1911, 1912].

Ras-el-Millan, Gulf of Suez; Dr. Robert Hartmeyer [A. H. Clark, 1912] (1, Berl. Mus., 5603).

Erg Tor, Gulf of Suez; Dr. Robert Hartmeyer [A. H. Clark, 1912 (as Eig Tor); Hartmeyer, 1916] (1, Berl. Mus., 5602).

Tor, Gulf of Suez [A. H. Clark, 1912].

Red Sea (probably Suez) [Audouin, 1817; A. H. Clark, 1909, 1911, 1912].

Ghardaqa, Red Sea [Mortensen, 1937].

Red Sea [von Martens, 1869; A. H. Clark, 1911, 1912, 1914].

Red Sea [P. H. Carpenter, 1881, 1888; de Loriol, 1893; A. H. Clark, 1911, 1912, 1914; Hartlaub, 1912].

Aden; Prof. Johannes Müller [P. H. Carpenter, 1881, 1888; de Loriol, 1893; Hartlaub, 1912; A. H. Clark, 1911, 1912] (1, Berl. Mus.).

Muscat [P. H. Carpenter, 1888; Hartlaub, 1912; A. H. Clark, 1912].

Geographical range.—The Red Sea and eastward to Muscat.

Bathymetrical range.—Littoral.

History.—In 1817 Jean Victor Audouin published in Savigny's "Description de l'Egypte" a figure of a comatulid identified only as *Comatula* sp., that undoubtedly represents this form. It was first definitely recorded from the Red Sea by Prof. Edouard von Martens as *Comatula carinata* in 1869.

Moseley in 1877 described the pigment in a specimen from Suez recorded as *Antedon* sp., which was probably this form, and his account of the coloring matter was noticed by MacMunn in 1890 and by Newbigin in 1898. In his preliminary report upon the comatulids of the *Blake* expedition published in 1881 Dr. P. H. Carpenter said he had seen specimens of *Antedon carinata* from the Red Sea and Aden, and had found it impossible to separate them specifically from others from Mauritius. In the *Challenger* report upon the comatulids published in 1888 Carpenter included Muscat, Aden, and the Red Sea among the localities where *Antedon carinata* is found. He said that in the few specimens that he had seen from Muscat and from the Red Sea the brachial carination and also the synarthrial tubercles are considerably less distinct than they are in those from the Indian Ocean, Brazil, or the Caribbean Sea (=St. Lucia); while both in the African (*carinata*) and in the Red Sea variety the terminal portions of the arms have stiffer pinnules and a less feathery appearance than in the Brazilian specimens.

In my first revision of the old genus *Antedon* published in 1907 this form was included under *Tropiometra carinata.* In 1909, in a review of Chadwick's report on the crinoids of the Sudanese Red Sea, I said that the first crinoids known from the Red Sea were *Tropiometra carinata* and *Heterometra savignii*, both of which were well figured by Savigny in 1817. In a paper on the recent crinoids of the coasts of Africa published in 1911 I included this form under *Tropiometra encrinus*, new species. The African localities were given as "Red Sea," Aden, and ?Suez, and I added that this species ranges eastward to the South Sea islands and the east coast of Asia; it appears to be generally rare, though common about Ceylon. I remarked that I was not absolutely certain that the Red Sea specimens of *Tropiometra* should be referred to this species, as I had never been able to examine any of large size, but they seem to be nearer *encrinus* of corresponding size than to any other form.

In his memoir on the comatulids of the *Blake* expedition published in 1912, Dr. Clemens Hartlaub mentioned *Antedon carinata* from Muscat and the Red Sea, taking the records from Carpenter.

In a paper on the crinoids of the Berlin Museum published in 1912, I said that my *Tropiometra encrinus* published as a new species in 1911 is in reality composed of three species, *Tropiometra encrinus*, *T. audouini*, new species, and *T. indica*, new species. Under *Tropiometra audouini* I recorded and gave notes upon specimens from Eig Tor and Ras-el-Millan, Gulf of Suez, and from Aden. These were the specimens I had in 1911 mentioned having seen. In my memoir on the crinoids of the Indian Ocean published in 1912, I included this form under *Tropiometra encrinus.* The localities given were Muscat, Aden, Tor, the Red Sea, and ?Suez. In a paper on the crinoids of west Africa published in 1914, I mentioned *Tropiometra audouini*, with the Red Sea as the locality.

In 1916 Dr. Robert Hartmeyer corrected my record (1912) of Eig Tor, Gulf of Suez, to read Erg Tor.

In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I included *audouini* in the key to the species of the genus *Tropiometra*, giving the Red Sea as the habitat. In a review of the smaller species of *Tropiometra* occurring in the Indo-Pacific region published in 1932, I included *Tropiometra audouini*, giving as the range Red Sea and eastward to Muscat.

Family CALOMETRIDAE A. H. Clark

Acoela group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 34, 99 131; for further references see under Charitometridae, Part 4c.

Multicolor group A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 127, 128 (new group to include multibrachiate species of the *Acoela* group; new species described; varied and handsome coloration in life noted).

Calometridae A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 649 (referred to the Oligophreata); Mem. Australian Mus., vol. 4, 1911, p. 725 (absent from Australia), p. 728 (new family to include four genera, not here named, covering the species assigned to *Calometra*); Crinoids of the Indian Ocean, 1912, p. 6 (exclusively confined to the East Indian region; number of genera and species), p. 9 (absent from Australia), p. 10 (greatly developed in Japan), p. 11 (occurs west to the Andamans), p. 23 (distribution in detail; 20–240 fathoms, average about 95 fathoms), p. 42 (new family, to include four genera for the species formerly included in the genus *Calometra*), pp. 45, 48, 50, 52 (in keys), p. 58 (key to genera), p. 177 (included *Calometra* and the new genera *Oreometra*, *Neometra*, *Gephyrometra*, and *Pectinometra*); Bull. Inst. Océanogr. Monaco, No. 294, 1914, pp. 7, 8 (relation to temperature); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical ranges); No. 20, 1914, p. 582 (relation to temperature of habitat).—Alexander, Rec. Western Australian Mus. and Art Gallery, vol. 1, pt. 3, 1914, p. 108.—A. H. Clark, Rec. Western Australian Mus. and Art Gallery, vol. 1, pt. 3, 1914, p. 115 (genus and species collected by the *Endeavour* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range; phylogenetical and paleontological significance); Die Crinoïden der Antarktis, 1915, p. 132 (covering plates compared with those of the Heliometrinae); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed philosophical discussion of the bathymetrical range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of the distribution of the Australian species); Smithsonian Misc. Coll., vol. 65, No. 10, 1915, p. 16 and following (phylogenetical study).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 21 (*Oreometra* a connecting form between this family and the Zygometridae, if not actually a member of the latter).—A. H. Clark, Unstalked crinoids of the *Siboga* Exped., 1918, p. 132; Smithsonian Misc. Coll., vol. 72, No. 7, 1921, p. 3.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 9, 94, 120; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 19, 42, 44, 55, 61, 79, 84, 85, 88, 90, 92, 100, 231, 280, 284; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 30.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 646.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 22, 25; Kungl. Fysiogr. Sällsk. Lund Forh., vol. 7, No. 1, 1936, p. 17.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, 1937, p. 103.—H. L. Clark, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 41.—Gislén, Lunds Univ. Årsskr., new ser., Avd. 2, vol. 34, No. 17; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 49, No. 17, 1939, p. 8 (disk completely plated).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 23 (in key), p. 53.

Diagnosis.—A family of the superfamily Tropiometrida in which the perisome of the pinnules is protected by conspicuous and highly developed side- and covering-plates; the disk is globose, compact, completely enclosed by a pavement of plates and easily detached; P_1 is very delicate, flexible, and weak with the first two segments enlarged and the remainder very small and about as long as broad; and P_2 and usually also some of the following pinnules are elongated, enlarged, and stiffened, and composed of much elongated segments. The muscular fossae on the articular faces of the radials are very short forming curved bands along the distal border of the interarticular ligament fossae (see Part 2, pp. 40–41, figs. 65, 66, p. 43).

Geographical range.—From western and northeastern Australia westward to the Andaman Islands and northward to the Philippines and southern Japan.

Bathymetrical range.—From 5 to 600 meters.

Thermal range.—From 8.67° C. to 17.22° C.

Remarks.—The species of the family Calometridae are very distinctive, the highly characteristic P_1, the solidly plated and more or less globular disk, which is easily detached, the highly developed side- and covering-plates, and the stiff pinnules making their recognition easy. Internally, the crescentic articular faces of the radials and the greatly reduced muscular fossae are almost unique. The delicate yellow and violet that characterize many species in life is otherwise found only in the genus *Homalometra* (Himerometridae); but some species are, or may be, wholly yellow, or yellow and brown, or even mostly brown.

On the basis of our present fragmentary knowledge the five included genera, *Reometra, Pectinometra, Neometra, Gephyrometra,* and *Calometra,* appear to be well characterized.

History.—The name Calometridae was first mentioned, with no indication of its significance, in a list of the families included in the suborder Oligophreata published in 1911. Later in the same year I said that I had "created a new family Calometridae containing four genera for the numerous species which I formerly placed in *Calometra.*" In 1912 the family Calometridae was defined, and *Calometra,* together with the new genera *Oreometra* (=*Reometra*), *Neometra, Gephyrometra,* and *Pectinometra* were assigned to it. Since then the status of the family has remained unchanged.

KEY TO THE GENERA OF THE FAMILY CALOMETRIDAE

a^1. IIBr series 4(3+4); proximal cirrus sockets encroaching on the surface of the radials (Queensland; 46–47 meters) **Reometra** (p. 347)

a^2. IIBr series 2, or with 10 arms only; proximal cirrus sockets not encroaching on the surface of the radials.

  b^1. P_2 or P_3 or both considerably longer than, usually from half again to twice as long as, the earlier genital pinnules, and more or less enlarged and stiffened; more than 15 arms.

    c^1. Division series in apposition with those on each side either directly or through more or irregularly developed lateral extensions; proximal portion of the animal compact, the sides in profile making a relatively small angle with the dorsoventral axis (Andaman Islands to Celebes and the Philippines, and northward to southern Japan; 155 [?115]—450 meters) **Pectinometra** (p. 375)

    c^2. Division series, at least beyond the IBr_1, very widely separated, the sides of the ossicles smooth and without lateral extensions; division series always making a very large angle with the dorsoventral axis, sometimes being practically at right angles to it.

      d^1. Interradial extensions of the radials broad, separating widely the bases of the IBr_1; lower pinnules comparatively stout (Andaman Islands and the western coast of Australia to the Philippine Islands and southern Japan; 20–600 meters) **Neometra** (p. 355)

      d^2. Interradial extensions of the radials not developed, or if present narrow and not separating the bases of the IBr_1; lower pinnules very slender (southwestern Japan to southern Annam; 5–174 meters) **Gephyrometra** (p. 351)

  b^2. P_2 and the following pinnules comparatively short, subequal in length; 10–15 arms (Kei Islands to the Moluccas and northward to southern Japan; 100–439 meters) **Calometra** (p. 385)

Genus REOMETRA A. H. Clark

Oreometra A. H. Clark, Zool. Anz., vol. 39, No. 11/12, 1912, p. 421 (occurs in the combination *Oreometra mariae,* a *nomen nudum*); Crinoids of the Indian Ocean, 1912, p. 10 (absent from Japan; reason), p. 58 (in key), p. 179 (diagnosis; genotype *O. mariae,* new species).—H. L. Clark, Biol. Results Fishing Experiments F. I. S. *Endeavour,* vol. 4, pt. 1, 1916, p. 21 (discussion).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 47, 1934, p. 14 (preoccupied; replaced by *Reometra*).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54 (history).

Reometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 47, 1934, p. 14 (new name for *Oreometra*, preoccupied).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54 (history).

Diagnosis.—A genus of Calometridae in which the arms are always more than 10 in number, with the IIBr series 4(3+4), exceptionally 3(2+3), and the cirrus sockets lie partly upon the centrodorsal and partly upon the radials.

Geographical range.—Known only from the coast of Queensland.

Bathymetrical range.—Known only from 46 or 47 meters.

History.—The generic name *Oreometra* first occurred in the combination *Oreometra mariae*, a *nomen nudum*, in a paper published on April 23, 1912. In my monograph of the crinoids of the Indian Ocean published on November 22, 1912, the genus *Oreometra* was diagnosed, and the genotype was given as *Oreometra mariae*, new species, which was described.

Dr. F. A. Bather was so very kind as to call my attention to the fact that my genus *Oreometra* was preoccupied by *Oreometra* Aurivillius, 1910 (Sjoestedt. Ergeb. Schwed. Exped. Kilimandjaro, 2 [9], p. 38), a genus of African moths of the family Geometridae. Accordingly in 1934 I changed the name *Oreometra* to *Reometra*.

REOMETRA MARIAE (A. H. Clark)

Antedon macronema Brit. Mus., MS.

Oreometra mariae A. H. Clark, Zool. Anz., vol. 39, 1912, No. 11/12, p. 421 (*nomen nudum;* cirrus sockets compared with those of *Neometra sibogae*); Crinoids of the Indian Ocean, 1912, p. 179 (description; habitat unknown); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 40 (same).—H. L. Clark, Biol. Results Fishing Experiments F. I. S. *Endeavour*, vol. 4, pt. 1, 1916, p. 21 (comparison with *O. pericalles*).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 136 (comparison of cirrus sockets with those of *Neometra sibogae*).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54.

Oreometra pericalles H. L. Clark, Biol. Results Fishing Experiments F. I. S. *Endeavour*, vol. 4, pt. 1, 1916, p. 20 (detailed description; locality; discussion), pl. 3, fig. 1.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54.

Reometra mariae H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54.

Reometra pericalles H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54 (locality).

Description.—The centrodorsal is thick discoidal, bearing a single fairly regular marginal row of cirrus sockets; the flat dorsal pole is 4 mm. in diameter.

The cirri are XV, 44–47 (usually 46–47), from 25 to 27 mm. long. All the segments are approximately equal in length, all being about twice as broad as long. The ventral and lateral distal edges of the segments project rather strongly over the bases of the succeeding segments. On about the fourth segment a faint very narrow longitudinal ridge is visible; after the middle of the cirrus this becomes a narrow low sharp carination and terminally grows into a fairly prominent rounded spine. In the distal third of the cirri supplementary spines appear, one on either side of the central carination; these at first are small and are confined to the vicinity of the distal edge, but on the terminal segments they become nearly as large as the median spine. The spine on the antepenultimate segment is single. The opposing spine is laterally broadened. The cirri are moderately stout and taper slightly in the outer half. They are rounded-rhombic in cross section, suggesting the cirri of *Neometra acanthaster*, though the corners are less sharp.

The radials are moderate in length and resemble those of *Neometra multicolor* except that they are not produced interradially. Their dorsal surface is marked by a series of semicircular pits or gouges which serve to accommodate the proximal portion of the cirrus bases. The cirrus sockets all lie partly on the centrodorsal and partly on the radials. The central canals of the cirri, however, always pierce the centrodorsal, though they may be only very slightly below the rim. The elements of the IBr series are united by an exceedingly close synarthry that appears like a syzygy in external view. The IBr_1 are oblong, from two and one-half to three times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long. The elements of the IBr series are broad, in close lateral apposition, and slightly flattened laterally just as in *Ptilometra australis*, and as in that species the ossicles are very thin dorsoventrally. The IBr_1 have a sharp tubercle in the middle near the proximal border, and another smaller one in the middle of the distal margin. The IBr_2 has a tubercle in the middle of each of the two anterior edges. The IIBr series are 4(3+4), the axillaries and preceding segments of the IIBr series resembling the corresponding ossicles of the IBr series. The $IIBr_1$ and the first brachials have each a median tubercle on the anterior border; the $IIBr_2$ has two tubercles on its proximal border.

The 17 arms are 60 mm. long, the brachials in general resembling those of *Pectinometra magnifica*. As in that species, there is a rather sharp overlap, especially at the distolateral angles. The arms do not become laterally flattened or carinate distally.

P_1 is about 7 mm. long, small and weak, flexible, and rather strongly prismatic, at first moderately stout but tapering rapidly after the basal third and becoming exceedingly slender and flagellate in the outer half. It is composed of 18 segments which proximally are broader than long, becoming slightly longer than broad distally. The first segment is about twice as broad as the second, though in comparison with the conditions in the other species of the family it does not seem to be especially enlarged. The second segment is also enlarged, but very slightly. It bears a small dorsal carinate process, as does also the third, which is not enlarged. P_2 is stiff and spinelike, 8 mm. long with 10 segments of which the first is short, the second is about as long as broad, and the remainder are much elongated with slightly spinous distal ends. P_3 and P_4 are equal, slightly longer than P_2 but similar to it, with 12 segments. The first segment of P_2 and sometimes also of P_3 has a slight rounded dorsal carination, but is not otherwise modified. P_5 is about as long as P_2, but is more slender distally and less spinous. The following pinnules are slightly shorter than P_5 with 11 segments which have slightly prominent distal ends. The distal pinnules are 9 mm. long. All the pinnules are strongly prismatic.

The side- and covering-plates along the pinnule ambulacra are highly developed. Sacculi are abundant.

The disk is lacking. The ventral view of the radial pentagon shows a very broad and shallow central cavity with a small central plug. The radial faces are broad laterally, but very narrow dorsoventrally, just as in *Neometra multicolor*.

Description of the type specimen of O. pericalles.—The centrodorsal is 6 mm. in diameter, slightly convex and smooth. There are 17 cirrus sockets the ventral portions of which extend well on to the radials.

The radials are in contact laterally. The IBr series are clearly separated from their neighbors, and the 2 elements of this series are united by syzygy. The IBr_1 are about 3 times as broad as long and bear a cylindrical, blunt, spinelike tubercle, sometimes a pair, on the proximal margin, and another on the distal margin in the median line. The IBr_2 (axillaries) are about 3 times as broad as long with a low obtuse distal angle. On each of the distal sides there are from 1 to 3 projections somewhat similar to those on the IBr_1 but flattened. The IIBr series are 4(3+4), in one case 3(2+3). On the first 3 segments the spinelike tubercle in the middle of the distal margin is prominent, while the axillary may have a somewhat smaller one on either side. An additional similar tubercle may be developed in connection with the well marked anterolateral angles.

The arms (number not given) are about 75 mm. in length. The earlier brachials are quadrilateral, with conspicuous anterolateral angles on the side bearing the pinnule. The median spinelike tubercle is also often developed. After the seventh or eighth the brachials tend to become triangular and the distal margins tend to flare, but there is no overlapping.

Syzygies occur between brachials 2+3 on arms following IIBr series, and between brachials 3+4 on arms arising directly from the IBr axillaries. The second syzygy is somewhere between the eighth and fourteenth brachials. The distal intersyzygial interval is 6 or 7 muscular articulations.

P_1 is about 7 mm. long, somewhat prismatic, curved inward, flexible, though not at all flagellate, and rather stout throughout. It is composed of about 15 segments of which the first is notably enlarged, but not the second. P_2 is erect and spinelike, not at all prismatic, about 13 mm. long, composed of 15 nearly cylindrical segments with spiny distal ends all but the terminal and two basal longer than broad. P_3 is very similar, perhaps a little longer. P_4 is similar, perhaps a little shorter than P_3. P_5 to P_{10} are similar but successively shorter and with fewer segments which have less and less spiny distal margins. P_{11} is about 8 mm. long and is composed of 11 segments. The succeeding pinnules are distinctly prismatic and gradually increase to about 10 mm. in length. The side- and covering-plates are well developed.

The color of the single dry specimen is purple and white. The centrodorsal, the dorsal surface of the arms and pinnules, and scattered spots elsewhere are white or whitish. The IBr series are dirty whitish with a purple tinge. The IIBr series, a few of the lowest brachials, a conspicuous line along each side of each arm, and the oral surface of the pinnules, at least on the basal portion, are more or less deep purple.

Localities.—Thirteen miles north by west of Double Island Point, Queensland; 46–47 meters; Australian Federal Fisheries Investigation Ship *Endeavour* [H. L. Clark, 1916] (1, Australian Mus.).

No locality [A. H. Clark, 1912, 1913] (1, B. M.).

Remarks.—From the fact that the type specimen of *Oreometra mariae* in the British Museum was designated *Antedon macronema* I suspected that it had come from eastern Australia. Its general appearance is sufficiently like that of *Ptilometra australis* to mislead anyone casually going over a collection of Australian echinoderms into referring it to that species; but had it been sent from any other region it certainly never would have been referred to this distinctively Australian form.

I cannot see any reason for supposing that *Oreometra pericalles* is specifically different from *R. mariae.* Dr. H. L. Clark says that the differences in the IBr series and in the pinnules forbid referring the type of *pericalles* to *mariae.* But the differences in the IBr series are due solely to the fact that in the specimen described as *pericalles* the IBr series are strongly turned outward. The differences in the pinnules of the two specimens as described are wholly negligible except for such as are correlated with the difference in size.

I cannot see any evidence whatever in favor of Dr. Clark's view that the genus *Reometra* "is a connecting form with the Zygometridae, if not actually a member of that family." Excepting for the occurrence of a syzygy, as described by him, between the ossicles of the IBr series, *Reometra* differs in every single detail from all the species of Zygometridae, while at the same time agreeing in practically all details with the other genera of Calometridae.

Although, thanks to Dr. Clark's kindness, I saw the type specimen of *Oreometra pericalles* during a visit to Cambridge, I did not have sufficient time to examine it in detail.

History.—The name *Oreometra mariae* first appears as a *nomen nudum* in my description of *Neometra sibogae* published on April 23, 1912. I noted that in *N. sibogae* "the cirrus sockets encroach more or less upon the radial as do those of *Oreometra mariae.*" *Oreometra mariae* was described in detail in my monograph of the crinoids of the Indian Ocean published on November 22, 1912.

In 1916 Dr. H. L. Clark described and figured *Oreometra pericalles*, and in 1934 Prof. Torsten Gislén listed *O. mariae* among the species having the *Heterometra bengalensis* type of arm division.

Genus GEPHYROMETRA A. H. Clark

Antedon (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 132.

Calometra (part) A. H. Clark, Smithsonian Misc. Coll. (Quarterly Issue), vol. 50, pt. 3, 1907, p. 363.

Pectinometra (part) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 180.

Gephyrometra A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 58 (in key), p. 184 (diagnosis; genotype *Antedon versicolor* A. H. Clark, 1907 [references on pp. 10, 23 are to *Calometra*]).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new sev., vol. 45, No. 11, 1934, p. 20.

Diagnosis.—A genus of Calometridae in which the arms are about 20 in number, with all the division series 2; P_3, the longest proximal pinnule, is nearly twice as long as the shorter genital pinnules, slender, but stiffened; the radials have no interradial extensions, or if these are present they are very narrow and the bases of the IBr_1 meet over them.

Geographical range.—From southwestern Japan to southern Annam.

Bathymetrical range.—From 5 to 174 meters.

Thermal range.—One record, 13.28° C.

History.—The genus *Gephyrometra* was formally diagnosed in my monograph of the crinoids of the Indian Ocean published on November 22, 1912, the genotype being given as *Antedon versicolor* A. H. Clark, 1907. Its status has not changed since it was first established.

GEPHYROMETRA VERSICOLOR (A. H. Clark)

Plate 36, Figure 189; Plate 39, Figure 204

Antedon versicolor A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 132 (color; description; *Albatross* station 4884).

Antedon propinqua A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 132 (color), p. 133 (description; *Albatross* station 4895).

Calometra propinqua A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed).

Calometra versicolor A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan; considered as including *propinqua*).

Pectinometra versicolor A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 180 (editorial error).

Gephyrometra propinqua A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 184 (locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (range and its significance).

Gephyrometra versicolor A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 184 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (range and its significance).—Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 5 (French Indo-China), p. 6 (range), p. 17 (locality; notes).

Description.—The centrodorsal is discoidal with the bare polar area flat. The cirrus sockets are arranged in two crowded rows, with about 3 immediately beneath each radial.

The cirri are XX–XXV, 45, 25 mm. long. The first segment is about twice as broad as long, or rather less, and the following gradually increase in length to the fifth which is about as long as broad; the following segments are slightly longer than broad those succeeding gradually decreasing in length so that the twentieth is about as long as broad and the remainder are not so long as broad, the terminal being about twice as broad as long. In the proximal half of the cirri the ends of the segments project somewhat, this feature gradually becoming less pronounced ventrally and more pronounced dorsally so that the segments in the distal half bear prominent dorsal spines. The opposing spine is in height equal to rather less than half the width of the squarish penultimate segment; it is triangular, and arises from the entire dorsal surface of the segment. The terminal claw is rather weak, not so long as the penultimate segment, and moderately curved.

The radials are visible as low interradial triangles; the apices of these triangles are sometimes produced in a narrow band.

The IBr_1 are oblong, short, between 3 and 4 times as broad as long, in apposition laterally though sometimes with the distal corners free, always meeting above the radials. The IBr_2 (axillaries) are broadly pentagonal, about twice as broad as long, sometimes with a thin lateral border, but always widely free. The IIBr series resemble the IBr series, but are relatively somewhat longer; the $IIBr_1$ are interiorly united.

The 20 arms are from 70 mm. to 90 mm. in length. The first brachials are wedge-shaped, about half again as long exteriorly as interiorly, united interiorly. The second brachials are similar, but exteriorly swollen and convex. The first syzygial pair (composed of brachials 3+4) is about as long as broad, with the inner side of the epizygal somewhat swollen. The next one or two brachials are oblong, not quite so long as broad, the following becoming wedge-shaped and soon more obliquely so, about as long as broad, with the longer side always rather strongly convex. Distally the brachials become gradually less obliquely wedge-shaped, but do not become elongate or oblong. The terminal brachials are very short and are much exceeded in length by the terminal pinnules.

Syzygies occur between brachials 3+4, and again about brachials 19+20, thence distally at intervals of from 2 to 4 (usually 3 or 4) muscular articulations.

P_1 is 7 mm. long, slender, delicate and flexible, composed of 20–30 segments of which the first is rounded wedge-shaped with the narrower end directed proximally and the broader end overlapping the entire lateral border of the hypozygal; it is thus somewhat broader than the length of the second brachial; the second segment is greatly expanded, but not so broad as the first; the following segments are subequal, about one third as broad as the second, and about as long as broad. P_2 10 mm. or 11 mm. long, stiff and spinelike, though comparatively slender, composed of 25 segments of which the first 2 are much enlarged as in P_1, the third is about as long as broad, and those following become progressively elongated, being distally about twice as long as broad. P_3 is 13 mm. long, and resembles P_2 but the segments are more elongate and the distal have somewhat overlapping and finely spinous ends. P_4 is similar to P_3, but 11 mm. long like P_2.

The following pinnules decrease in length to P_9, which is 7 mm. long with 15 segments of which the first 2 are very broad and the remainder are about twice as long as broad, then gradually increase in length reaching 11 mm. distally. The first three pinnules are rounded styliform, those succeeding more sharply styliform and slightly stouter, remaining so until the end of the arm. The terminal pinnules extend 4.5 mm. beyond the tip of the arm. The enormous expansion of the first 2 pinnule segments is most noticeable on the weak and slender P_1; it is of the same size absolutely, though relatively less, on the somewhat stouter succeeding pinnules. After P_4 it becomes absolutely smaller, and from that point onward the first segment is very short, about half again as broad as the third, and the second is short and intermediate between the first and third.

Notes.—The two known specimens of this form were originally considered as representing different species distinguished by the presence or absence of anterior interradial extensions of the radials. In the type of *versicolor* the radials are interradially produced upward in the form of a very narrow interradial process over the distal end of which the IBr$_1$ meet, and the larger part of the IBr$_1$ and the IBr$_2$ are widely separated laterally. In the type of *propinqua* the radials appear externally as small interradial triangles with no distal processes and the IBr$_1$ are in apposition for their entire lateral edges, though the IBr$_2$ are widely separated.

Further study showed that the condition of the interradial portion of the radials is variable in each individual, and certain interradial areas in one are quite similar to interradial areas in the other. A study of a very much larger series of *Neometra multicolor* than was available at the time the original descriptions were written has led me to regard the presence or absence of anterior prolongations of the radials in the interradial angles as a minor varietal rather than as a specific character.

In the type of *versicolor* the cirri are XX–XXV, 45, 23 mm. long, with the longest segments about as long as broad. The 20 arms are 90 mm. long, and are composed of 130 brachials. P_1 is 7 mm. long with 30 segments. P_2 is 10 mm. long, stiff and spinelike, with 25 segments. P_3 is 13 mm. long, resembling P_2. P_4 is similar but slightly shorter. P_9 is 7 mm. long with 15 segments.

In the type of *propinqua* the cirri are XXV, 45, 25 mm. long, with the segments in the basal half rather longer than broad. The 20 arms are 70 mm. long with about 120 brachials. P_1 has 20 segments. P_2 is much longer and stouter, stiff and rodlike, with about 15 segments. P_3 is even longer and stiffer, after which the pinnules decrease to about P_8, thence increase very slightly distally.

One of the specimens from Annam, as described by Gislén, has the centrodorsal discoidal, 5.5 mm. in diameter, with the bare dorsal pole flat and 4 mm. in diameter. The cirri are arranged in a partially double row. The cirri are XXI, 47–52, from 23 to 26 mm. long. The sixth segment is about as long as broad, those following decreasing to about half again as broad as long. The proximal segments have a longitudinal dorsal carination which after about the twenty-fifth develops into a high ridge that later is transformed into a dorsal spine. The radials are visible as narrow bands, broader interradially, but not separating the IBr_1. The IBr_1 are three times as broad as long and are laterally united in the proximal third above the radials. The IBr_2 (axillaries) are pentagonal, one-third again as broad as long; with the IBr_1 they form an indistinct synarthrial tubercle. The ossicles of the IBr series have no ventrolateral extensions. The IIBr series are 2. There are 19 arms about 90 mm. long, composed of about 125 brachials which are rounded and inconspicuously carinate distally. The distal intersyzygial interval is 3 muscular articulations. P_1 is 11 mm. long with 28 segments, slender and flexible beyond the first two very broad segments. The longest segments are one-third again as long as broad. P_2 is 16 mm. long with 20 segments, and is stiffened. The first two segments are short, and the distal are from two to two and one-half times as long as broad with spinous distal ends. P_3 is 20 mm. long with 23 segments, and is similar to P_2. P_9 is 13 mm. long with 15 segments. The distal pinnules are 12 or 13 mm. long. The disk is globose, completely enclosed by calcareous plates, and bears five unbranched ambulacral furrows. The anal cone is long and pointed. The color is white, mottled with violet; the cirri are brownish, and the disk is white.

The other specimen from Annam, which is much broken, is similar. The cirri have 40–50 segments. One IIIBr 2 series is present. On some rays P_2 is as short as P_1 (regenerated).

Localities.—*Albatross* station 4895; Eastern Sea, southwest of the Goto Islands; Ose Saki light bearing N. 42° E., 4.7 miles distant (lat. 32°33′10″ N., long. 128°32′10″ E.); 174 meters; temperature 13.28° C.; green sand, broken shells, and pebbles; August 9, 1906 [A. H. Clark, 1907] (1, U.S.N.M., 22621).

Albatross station 4884; Eastern Sea, about 20 miles southwest of Nagasaki entrance; Nomo Zaki bearing N. 76° E., 11.5 miles distant (lat. 32°32′00″ N., long. 129°30′45″ E.); 97 meters; temperature 16.50° C.; dark gray sand and broken shells; August 8, 1906 [A. H. Clark, 1907] (1, U.S.N.M., 22620).

Nha'trang Bay, Annam; 5 meters; Dr. C. Dawydoff [Gislén, 1937].

Geographical range.—From southwestern Japan southward to Annam.

Bathymetrical range.—From 5 to 174 meters.

Thermal range.—Two records, 13.28° and 16.50° C.

History.—This species was described in 1907 as *Antedon versicolor* from a specimen from *Albatross* station 4884, and on the page following as *Antedon propinqua* from a specimen from *Albatross* station 4895, these two supposed species being transferred to the genus *Calometra* later in the same year. In 1908 *Calometra versicolor* was considered as including *C. propinqua* as a synonym.

In 1912 in my monograph on the crinoids of the Indian Ocean I inadvertently mentioned *Pectinometra versicolor*. A few pages farther on I established the genus

Gephyrometra listing under it as nominal species *G. versicolor* and *G. propinqua*, giving the synonymy and range of each.

In 1936 Prof. Torsten Gislén recorded and gave notes on two specimens of *Gephyrometra versicolor* that had been collected at Nha'trang, southern Annam, by Dr. C. Dawydoff.

Genus NEOMETRA A. H. Clark

Antedon (part) H. L. Clark, *in* McClendon, Bull. Amer. Mus. Nat. Hist., vol. 23, 1906, pp. 120, 125, 126, and following authors.

Calometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 362.

Neometra A. H. Clark, Zool. Anz., vol. 39, 1912, No. 11/12, p. 421 (used as a generic name in the description of *Neometra sibogae*); Crinoids of the Indian Ocean, 1912, p. 11 (occurs in the Andamans), p. 23 (range), p. 58 (in key), p. 181 (diagnosis; genotype *Antedon multicolor* A. H. Clark, 1907; systematic position); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 130 (characters of the species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (discovery of 2 new types by the *Siboga*), p. 132 (key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 9 (relationship to *Calometra*), pp. 94, 95, 96; Zool. Bidrag Uppsala, vol. 9, 1924, p. 100.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 54 (key to the Australian species).

Diagnosis.—A genus of Calometridae in which the arms are 15–40 in number, all the division series being 2; the radials are extended interradially in the form of more or less broad interradial processes which entirely and usually rather widely separate the bases of the IBr_1; the ossicles of the division series are narrow with no lateral extensions; the division series always make a wide angle with the dorsoventral axis; and the longest oral pinnules are much longer than the shorter genital pinnules.

Geographical range.—From the Andaman Islands and the western coast of Australia to the Philippine Islands, and northward to southern Japan as far east as Tokyo Bay.

Bathymetrical range.—From 20 to 600 meters.

Thermal range.—From 13.28° C. to 15.89° C.; but there are only 3 records all of which refer to a single species.

History.—The generic name *Neometra* was first used in the description of *Neometra sibogae* published on April 23, 1912. Later in the same year, on November 22, the genus *Neometra* was formally diagnosed, and *Antedon multicolor* A. H. Clark, 1907, was given as the genotype. There has been no change in the status of the genus since that date.

KEY TO THE SPECIES IN THE GENUS NEOMETRA

- a^1. Dorsal processes on the outer cirrus segments triple, consisting of a median carination with a dorsolateral keel on each side of it; usually about 40 arms.
  - b^1. Cirri XVII–XIX, 39–50, very stout, 35–45 mm. (usually about 40 mm.) long; dorsolateral processes but little shorter and lower than the median keel, developed from the fifteenth segment onward; division series, brachials, and cirrus segments with unmodified distal edges, so that the animal appears smooth (west coast of Australia; 146–219 meters). **gorgonia** (p. 356)
  - b^2. Cirri XV, 31–36, rather slender, about 25 mm. long (one-third of the arm length); dorsolateral processes much lower than the median keel, developed only toward the tip of the cirrus; division series with everted borders and cirrus segments and brachials with produced distal edges, giving the animal a very rough aspect (Lesser Sunda Islands; 113 meters). **sibogae** (p. 358)

a^2. Dorsal processes on the outer cirrus segments consisting of a median keel only; not more than 30 arms.

b^1. Arms 30 in number; midventral line of the cirri sharp (Philippine Islands; 89 meters). **acanthaster** (p. 363)

b^2. Arms 20 or fewer; cirri ventrally rounded.

c^1. Cirri long, nearly half the arm length; longest cirrus segments twice as long as broad; synarthrial tubercles very high and prominent, as high as broad at the base; 16–17 arms; 42–50 cirrus segments (Kei Islands and Timor; 73–90 meters) ------------------ **diana** (p. 360)

c^2. Cirri shorter, their length not more than one-third the arm length; synarthrial tubercles not developed

d^1. Cirrus segments 38–55 in number

e^1. Longest cirrus segments nearly twice as long as broad; cirri with 38–41 segments; 14 arms 85 mm. long (Kei Islands; 85 meters) ------------------------ **sappho** (p. 361)

e^2. Longest cirrus segments not longer than broad

f^1. Cirri slender and short, less than one-fifth the arm length, with 42–55 segments; 20 arms (Andaman Islands; 302 meters) ---------------------- **spinosissima** (p. 364)

f^2. Cirri longer, from one-fourth to one-third the arm length, with 39–46 segments

g^1. Arms very narrow; distal edges of the brachials rather strongly produced; distal edges of the cirrus segments prominent; cirri more than one-third of the arm length, and rather slender; first segment of P_1 with a high rounded dorsal process, and from half again to twice as broad as the second; first segment of P_2 with a prominent high dorsal process; 15–20 arms (Philippine to the Lesser Sunda Islands; 77–113 meters) ------------------------------------- **alecto** (p. 367)

g^2. Arms broader and more rounded dorsally; distal edges of the brachials less produced; cirri less than one-third of the arm length and stouter, the distal edges of the segments not modified; first segment of P_1 not produced dorsally, and only slightly broader than the second; first segment of P_2 without a dorsal process; 20 arms (west coast of Australia; 146–219 meters) ---------- **conaminis** (p. 366)

d^2. Cirrus segments 35 in number; 20 arms (southern Japan; 20–600 meters). **multicolor** (p. 369)

NEOMETRA GORGONIA A. H. Clark

PLATE 36, FIGURE 190

[See also vol. 1, pt. 2, figs. 839–842 (side- and covering-plates), p. 405.]

Neometra gorgonia ALEXANDER, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 108 (*nomen nudum*; between Fremantle and Geraldton).—A. H. CLARK, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 115 (discovery; faunal relationships), pp. 125–128 (between Fremantle and Geraldton, 80–120 fms.; description of the type specimen, and characters of the others), p. 131 (specific characters; range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (detailed account of distribution).—H. L. CLARK, Biol. Results Fishing Experiments F. I. S. *Endeavour*, vol. 4, pt. 1, 1916, p. 6 (characteristic of west Australian subregion).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 132 (in key; range).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.—H. L. CLARK, Mem. Mus. Comp. Zool., vol. 55, 1938, p. 41 (notes on a paratype).—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 54 (locality).

Diagnostic features.—The dorsal processes on the outer cirrus segments are triple, consisting of a high median keel with a similar keel but little shorter and lower on either side of it; there are about 40 arms; the cirri are very stout with 39–50 segments; and the division series, brachials and cirrus segments have unmodified distal ends so that the animal presents a smooth appearance.

Description.—The centrodorsal is discoidal, broad, with a broad and flat bare polar area from 5 to 6 mm. in diameter. The cirrus sockets are arranged in one and a partial second crowded and irregular marginal rows.

The cirri are XIX, 39–50, from 35 to 45 (usually about 40) mm. long, large and stout, with a pronounced taper in the distal half. The first 9 or 10 segments are from half again to twice as broad as long, usually nearer the latter, the first being similar to those succeeding. The segments following the ninth or tenth gradually become shorter, but at the tip of the cirri the segments slowly increase in length again. The tenth segment has on the dorsal side just within the distal border an inconspicuous slightly elongated median tubercle which on those succeeding slowly transforms into a narrow and low, though prominent, median carination running the entire length of the segments. On the fifteenth segment two small tubercles appear, one on either side of the median carination just within the distal edge. These increase in size and elongate, after two or three segments becoming prominent low narrow keels which resemble the median keel, though they are slightly less in height and do not extend quite so far toward the proximal border of the segment; they are not quite parallel to the median keel, but converge slightly toward the proximal end of the segments. Distally all three carinate processes increase in height, especially the median, and a tubercle, which may be more or less elongate, usually appears just outside the distal end of each of the lateral keels. Because of the terminal taper of the cirri the opposing spine and terminal claw are rudimentary.

The radials are short in the middorsal line but extend upward in the interradial angles in the form of broad processes with parallel or slightly converging sides which entirely and widely separate the bases of the IBr_1; these processes are sharply truncated distally and are not expanded or spatulate, The IBr_1 are short, oblong, four or five times as broad as long. The ventrolateral edge is produced into a thin border which, viewed dorsally, is seen to run from the distal edge of the interradial process of the radials to the distal lateral angles of the IBr_1 where it disappears from dorsal view, being continued along the ventral side of the axillary and of the division series forming a deep trough in which the soft parts lie. The IBr_2 (axillaries) are broadly pentagonal, nearly twice as broad as long. The lateral edges are little, if any, shorter than those of the IBr_1 with which they make a broadly obtuse angle. The IIBr and IIIBr series are 2; all the latter are developed. The division series extend outward almost horizontally.

The 40 arms are from 60 to 95 mm. long and resemble those of the other species of the genus. There is little or no overlapping of the distal edges of the brachials.

P_1 is 14 mm. long with 28 segments of which the first two are greatly enlarged, over twice the breadth of those succeeding, with the distal edge more or less convex; the third or third and fourth are slightly broader than long; and the remainder are subequal, slightly longer than broad; as a whole the pinnule is proportionately longer and somewhat stouter and stronger than is usual in the genus. P_2 is 18 mm. long with 19 segments and resembles P_3, but is very slightly less stout. P_3 is 19 mm. long, very stiff and spinelike, with 19 segments of which the first two are broader than long, slightly enlarged, with distal carinate processes the edges of which are straight and parallel with the longitudinal axis of the pinnule or nearly so, the third is nearly as long as broad, and those following are elongate with, after the eight, produced distal edges which at the prismatic angles are provided with prominent spines. P_4 is 14 mm. long with 15 segments and resembles P_3 but is less stout and has the first two segments less enlarged. P_5 is 10 mm. long with 12 segments and is more slender than P_4. The distal pinnules are very sharply triangular in cross section, 9 mm. long with 15 segments of which the terminal four or five, over which the ambulacral grooves do not extend, abruptly smaller than those preceding. They resemble the distal pinnules of the other species of the genus.

The side- and covering-plates resemble those of *N. alecto*.

Notes.—Another specimen has 42 arms; there are two IVBr series, both developed on the inner side of external IIIBr series; the dorsal pole of the centrodorsal is from 6 to 7 mm. in diameter; the cirri are XXII, 44–46, from 35 to 40 mm. long; the color is white, the outer portions of the arms narrowly banded, and the pinnules broadly blotched, with purple.

A third specimen has 41 arms about 75 mm. long; the cirri are XX, 39–44, from 35 to 40 mm. long.

A fourth specimen has about 40 arms 65 mm. long; the cirri are about 30 mm. long; the color is white, the arms beyond the division series narrowly and regularly banded with purple, the bands being continued on to the pinnules.

A fifth specimen has 40 arms 60 mm. long; the dorsal pole of the centrodorsal is 5 mm. in diameter; the cirri are XXI, 34–39, 25 mm. long.

A sixth specimen has about 40 arms; there are two IVBr series.

A seventh specimen has 40 arms and is similar to the preceding.

Dr. Hubert Lyman Clark wrote in 1938 that he had before him one of the paratypes of this species, probably either the sixth or seventh specimen in the preceding list. He said that all the arms are broken, but more than 36, and probably 40, were present. There are two IVBr series. There are X cirri, all broken, and 13 sockets on the margin of the large flat centrodorsal.

Locality.—Between Fremantle and Geraldton, Western Australia; 146–219 meters; Australian Fisheries Investigation steamer *Endeavour* [Alexander, 1914; A. H. Clark, 1914, 1915, 1918; H. L. Clark, 1916, 1938; Gislén, 1934] (7, U.S.N.M., 35556; W. A. M.).

History.—This species was described in 1914 from seven dredged by the *Endeavour*, and has not been reported since. In 1938 Dr. H. L. Clark published some notes on one of the paratypes.

NEOMETRA SIBOGAE A. H. Clark

Plate 38, Figures 197, 198

Neometra sibogae A. H. Clark, Zool. Anz., vol. 39, 1912, No. 11/12, p. 421 (description; *Siboga* station 305); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 126 (comparison of postradial series with those of *N. gorgonia*), p. 128 (specific relationships; peculiarities of distal cirrus segments), p. 130 (characters; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. viii (a new type discovered by the *Siboga*), p. 132 (in key; range), p. 135 (detailed description; station 305), p. 276 (listed), pl. 21, figs. 51, 52.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 96 (characters of the lower pinnules); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.

Diagnostic features.—The dorsal processes on the terminal cirrus segments are triple as in *N. gorgonia*, but they differ from those in that species in being only developed toward the tip of the cirri and also in consisting of a high median keel flanked by a low ridge on either side; there are about 40 arms; the cirri are rather slender, only about one-third of the arm length, with 31–36 segments; and the ossicles of the division series have everted borders and the brachials and cirrus segments produced distal ends giving the animal a rough appearance.

Description.—The centrodorsal is thin discoidal with the broad polar area flat and 4 mm. in diameter. The cirrus sockets are arranged in a single fairly regular row.

The cirri are XV, 31–36, about 25 mm. long, large and stout, their bases crowded against those of their neighbors and their first segments more or less sharply flattened laterally. The first two segments are about twice as broad as long, those following gradually increasing in length and becoming nearly, sometimes quite, as long as broad on the fifth. The next two or three segments are similar, the following very gradually decreasing in length so that those in the outer fourth of the cirri are about twice as broad as long. In the distal fourth or fifth the cirri taper very gradually so that the tip is comparatively slender. The distal edge of the segments all around is everted and prominently overlapping. From the tenth onward the dorsal surface of the segments is sharply carinate. At first this affects only the distal part, but it soon comes to involve the entire dorsal surface of the segments, standing up in the form of a high median keel the crest of which is parallel to the longitudinal axis of the cirrus. On the terminal twelve or thirteen segments the high median carination is accompanied on either side by a usually more or less elongate tubercle which, however, is comparatively small and inconspicuous and much less developed than the corresponding structure in *N. gorgonia.*

The radials are even with the rim of the centrodorsal in the midradial line but are strongly produced in the interradial angles where they separate widely the bases of the IBr_1; the distal edge of these anterior processes, which are straight and not spatulate or otherwise modified, is equal in length to the lateral edges of the IBr_1. The cirrus sockets encroach more or less upon the radials as do those of *Reometra mariae.* The division series, which extend out horizontally from the radials, are very narrow and very strongly rounded so that they are very widely separated. The extreme ventrolateral border of the ossicles of the division series is produced in the shape of a thin flange with a smooth and sharp outer border which runs from the distal edge of the interradial production of the radials to the second brachial, but the produced borders are dorsally only visible as far as the IBr axillary. From the ends of the interradial processes of the radials these produced borders as viewed ventrally are parallel as far as the IIBr axillary, but as the IIBr series make a very considerable angle with each other they disappear dorsally at the IBr axillary. Extra division series are always external.

The 30–40 arms are from 70 to 75 mm. long, and resemble those of *N. multicolor.*

P_1 is 10–11 mm. long, slender though not so weak as is usually the case in species of this genus, with 29 segments of which the first two are enormously enlarged, subequal, from three to four times as broad as long, nearly twice as large as the first two segments of P_2. The third segment occupies about one-third the distal border of the second and is about as long as broad. The following segments are slightly longer than broad, becoming about as long as broad in the distal half of the pinnule. This pinnule is more or less stiffened. P_2 is 11–12 mm. long, straight and stiff though not particularly enlarged, composed of 18–21 segments of which the fourth and following are about twice as long as broad. The first is about three times as broad as long in the median line and about twice as broad basally as the third. The second is about as long though not quite so broad and bears a slightly rounded carinate process. The third is about half again as long as broad. P_3 is 15 mm. long with 17 segments which are more elongate than those of P_2, being nearly or quite three times as long as broad. The pinnule is in general similar to P_2 but is very slightly stouter with the first two segments only very slightly enlarged and the second with the carinate process much reduced. The third segment is narrowly carinate, at least basally. P_4 is 11 mm. long with 15 segments, those beyond the third very long, and the second-fourth slightly carinate. P_5 is 9 mm. long with 13 segments, resembling P_4 but with slightly shorter segments.

Locality.—*Siboga* station 305; Lesser Sunda Islands; Solor Strait, midchannel, off Kampong Menanga; 113 meters; stony bottom; February 8, 1899 [A. H. Clark, 1912, 1918] (4, U.S.N.M., E. 429; Amsterdam Mus.)

Remarks.—This species is known only from the four specimens collected by the *Siboga* in 1899.

NEOMETRA DIANA (A. H. Clark)

PLATE 37, FIGURES 195, 196

[See also vol. 1, pt. 2, fig. 200 (lateral view), p. 130.].

Calometra diana A. H. CLARK, Zool. Anz., vol. 39, 1912, No. 11/12, p. 422 (description; *Siboga* station 294).

Neometra diana A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. VIII (a new type discovered by the *Siboga*), p. 132 (in key; range), p. 133 (detailed description; stations 260, 294), p. 275 (listed), pl. 22, figs. 55, 56.—GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 88, 90 (synarthrial tubercles); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Neometra (*Calometra*) *diana* GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 96 (characters of the lower pinnules).

Diagnostic features.—In this species the synarthrial tubercles are greatly elongated and very conspicuous, as high as broad at the base, and the cirri are long, nearly half as long as the 16–17 arms, with 42–50 segments of which the longest are twice as long as broad.

Description—The centrodorsal is thin discoidal with the flat dorsal pole 3.5 mm. in diameter. The cirrus sockets are arranged in a single fairly regular marginal row.

The cirri are XVI, 42–43, from 30 to 33 mm. long, rather slender, resembling those of *Calometra discoidea*. The fifth-tenth segments, which are the longest, are about twice as long as broad. The distal fifteen or sixteen are slightly broader than long, but the cirri taper slightly at the tip so that the last three before the penultimate are as long as broad or slightly longer. The earlier segments show a slight tendency to become centrally constricted, and the short distal segments possess the usual high carinate dorsal spines.

The radials are short in the median line but extend far up in the angles of the calyx where they form a broad process with parallel sides and a straight or convex distal border which entirely and widely separates the bases of the IBr_1. In width this anterior process from the radials is equal to about half the length of the ventrolateral edge of the IBr_1. The IBr_1 are oblong, nearly or quite three times as broad as long, with the ventrolateral edge produced into a thin flangelike border with a smooth outer edge which is about twice as wide proximally as distally, proximally being even with the distal edge of the radial process. The IBr_2 (axillaries) are broadly pentagonal, not quite twice as broad as long. The dorsal surface is slightly excavated so that the distal edges appear prominent. The thin produced ventrolateral border of the IBr_1 is continued on to the IBr_2 where, viewed ventrally, it is seen to have its sides parallel, and viewed dorsally it disappears beneath the produced lateral angles of the axillary. The IBr_1 sometimes bear a small rounded tubercle just anterior to the proximal half of the synarthrial tubercle. The IBr_2 have a more or less prominent narrow rounded median carination running anteriorly from the base of the distal half of the synarthrial tubercle, often terminating, approximately on a level with the lateral angles, in a prominent tubercle. Both these features are repeated on the ossicles of the IIBr series and on the first two brachials. The synarthrial tubercles are small and narrow but greatly produced, as in *Perometra diomedeae.* They are proportionately smaller and narrower than in that species, though nearly as high. The IIBr series are 2.

The 16 arms are about 70 mm. long. The brachials are essentially as in *N. multicolor*, but each bears a prominent low, narrow, rounded carination which ends distally in a more or less spinous production of the distal edge. This carination lies alternately on either side of the median line, the alternation being most pronounced in the proximal part of the arm.

P_1 is 10 mm. long, slender and weak, with from 28 to 33 segments of which the first two are enormously enlarged and the remainder very small, about as long as broad. P_2 is 13–15 mm. long, stiff, and spinelike, though rather slender, with 18–22 segments. P_3 is 17 mm. long with 20 segments, resembling P_2 but slightly stouter and composed of slightly longer segments of which the first two are only slightly enlarged.

Localities.—*Siboga* station 294; south of Timor (lat. 10°12′16″ S., long. 124°27′18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1912, 1918] (11, U.S.N.M., E. 476; Amsterdam Mus.).

Siboga station 260; Kei Islands; 2.3 miles N. 63° W. from the northern point of Nuhu Jaan (lat. 5°36′20″ S., long. 132°55′12″ E.); 90 meters; sand coral and shells; December 16, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From the Kei Islands to Timor.

Bathymetrical range.—From 73 to 90 meters.

History.—This species was described as *Calometra diana* in 1912, and was transferred to the genus *Neometra* in 1918. Various structural features were discussed by Prof. Torsten Gislén in 1922, 1924, and 1934. As yet it is known only from *Siboga* stations 260 and 294.

NEOMETRA SAPPHO, new species

Diagnostic features.—The dorsal processes on the outer cirrus segments consist of a median keel only; the cirri are less than one-third the arm length with 38–41 segments of which the longest are nearly twice as long as broad; there are 14 arms 85 mm. long; synarthrial tubercles are not developed.

Description.—The centrodorsal is thin, discoidal, with the dorsal pole flat. The cirrus sockets are arranged in a single regular marginal row.

The cirri are VIII, 38–41, from 20 to 25 mm. long, slender and delicate. The first segment is between two and three times as broad as long, the second is half again as broad as long, the third is as long as broad or slightly longer than broad, and the fourth-sixth are nearly twice as long as broad. The segments following slowly decrease in length, becoming about as long as broad on the tenth or eleventh, then broader than long, and distally half again as broad as long. On the fourth or fifth the median portion of the distal dorsal edge projects slightly; this projection increases in amount and moves proximally as a ridge so that in the outer portion of the cirri high carinate dorsal spines are developed. These spines are short, so that they are widely separated from each other; they have the crest finally straight and parallel to the axis of the segments that bear them. On the last 10 or 11 segments preceding the penultimate they become narrowed into prominent median erect conical tubercles.

The radials extend well beyond the rim of the centrodorsal in the mid-radial line, and are produced interradially, the adjacent sides of two adjoining radials widely separating the bases of the IBr_1. The sides of these interradial processes are slightly convergent, and the width of the distal edge is more than half the length of the sides of the IBr_1. The IBr_1 are from two and one-half to three times as broad as long in the median line. The ventrolateral borders are produced, and the sides of these produced portions are straight and coverge slightly distally. The IBr_2 (axillaries) are somewhat longer than broad. The proximal portion of the ventrolateral border is produced, in continuation of the production on the IBr_1, and these lateral processes continue the convergence of those on the IBr_1 so that they disappear beneath the lateral angles about halfway from the proximal border to the apex. The unusually long axillary is slightly constricted centrally. The distal edges are rather strongly concave, the chords of the concavities making slightly more than a right angle with each other. A low narrow rounded median ridge runs from the proximal border of the IBr_1 to a point beneath the apex of the axillary. The IIBr series are 2, and are much narrower than the IBr series because of the absence of the projection of the ventrolateral borders. The $IIBr_1$ are about as long as broad. The $IIBr_2$ (axillaries) are about as long as the maximum width. The IIBr series have the same low median carinate lies as the IBr series. There are no synarthrial tubercles.

The 14 arms are 85 mm. long and very slender; all the brachials are longer than broad. The first syzygial pair (composed of brachials 3+4) is nearly twice as long as broad. A very low and narrow sharp median carination, like a fine hair line, runs the whole length of the arms.

On an arm arising from a IIBr axillary P_1 is 7 mm. long, flexible and exceedingly delicate and hairlike. It is composed of 26 segments of which the first two are enormously enlarged. The first segment is about three times as broad as long, including the distal carinate process which is either rounded or sharply pointed, and overlaps the base of the third brachial (the hypozygal of the first syzygial pair). The second segment is about half as broad as the first, and is between two and three times as broad as long. The third segment is scarcely more than half as broad as the second, and is about as long as broad, or slightly broader than long. From the third segment onward the pinnule tapers very gradually to the tip. The fourth and following segments are all somewhat longer than broad, but none are so much as half again as long as broad. P_2 is 15 mm. long, stiff and spinelike though very slender, and is composed of 19 segments. The first segment is wedge-shaped with the base of the wedge proximal, and is about twice as broad as the median length. The second segment is slightly longer than broad, and trapezoidal, the sides converging distally.

The third segment is two and one-half times as long as broad, and those following increase in length, the distal being four times as long as broad. The terminal segment is about four times as long as the basal width, conical, ending in a sharp point or in a small group of spines. The second and following segments have a faint keel on the outer side. The distal border of the third segment is armed with minute spines. On the succeeding segments these increase in size so that the last eight or nine have the distal border armed with long though exceedingly fine spines. P_3 is 16 mm. long with 17 segments. It resembles P_2 but is very slightly stouter, the first segment is not so broad, the following segments are relatively longer, and the carination running along the outer side is more prominent. P_4 is 15 mm. long with 17 segments. It resembles P_3 but is slightly more slender. Distally it is about as slender as P_2, but it is somewhat stouter basally, tapering more rapidly on the first six or seven segments. P_5 is 13 mm. long with 16 segments, and is more slender than P_4, especially beyond the basal third. The third-fifth segments support a gonad, and their ventrolateral borders are slightly extended beneath it. The pinnules immediately following are similar, these later passing into the sharply prismatic distal pinnules. On an arm arising from a IBr axillary P_1 is as described; P_2 is 11 mm. long with 13 segments; P_3 is 14 mm. long with 13 segments; P_4 resembles P_5 on arms arising from a IIBr axillary and bears a gonad. It is 12 mm. long with 15 segments. On arms arising from a IBr axillary the enlarged oral pinnules are shorter and more slender than on arms arising from a IIBr axillary.

Locality.—Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 54; 85 meters; sand and coral; May 9, 1922 (1, C. M.).

Remarks.—In the absence of triple dorsal processes on the outer cirrus segments, the absence of ventral carination of the cirri, the elongate earlier cirrus segments, the small number of arms, and the slender build, this species agrees with *N. diana.* It differs, however, in having much shorter cirri with only half as many segments, in lacking synarthrial tubercles, and in various other details.

NEOMETRA ACANTHASTER (A. H. Clark)

[See vol. 1, pt. 1, fig. 89 (lateral view), p. 147.]

Calometra acanthaster A. H. Clark, Smithsonian Misc. Coll., vol. 52, part 2, 1908, p. 224 (description; *Albatross* station 5153); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544 (specific relationships; cirri compared with those of *alecto*).

Neometra acanthaster A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 184 (synonymy; locality); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 128 (specific relationships), p. 130 (characters; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 132 (in key; range); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 9, fig. 45.—Gislén, Kungl. Fysiog. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.

Diagnostic features.—This species seems to be easily distinguished from all the others in the genus by the sharp carination of the midventral line of the cirri, combined with the presence of 30 arms resulting from the occurrence of IIIBr series on the outer side of each ray. The cirri have about 35 segments and are about one third of the arm length.

Characters.—This species comes nearest to *N. multicolor* from which it differs in a number of features that appear to be perfectly constant.

The cirri, 20 mm. long, are composed of the same number of segments as are those of *N. multicolor.* In *N. multicolor* the segments in the distal half of the cirri are rounded ventrally, their distal ends on the ventral side are even with the proximal ends of the succeeding segments, the width is about twice the length in the middle lateral line, and the dorsal spines arise from one-half or rather less of the dorsal surface and are small and pointed. In *N. acanthaster* the distal half of the cirri is sharply carinate ventrally, the distal ends of the segments are prominent, overlapping the bases of the succeeding segments, the segments themselves are broader, being about 3 times as broad as long in the lateral line, and the dorsal spines, which arise from the entire dorsal surface of the segments are high and terminate in a long ridge parallel to the longitudinal axis of the cirri instead of in a point.

The arms, 60 mm. long, are 30 in number instead of 20 or less as in *N. multicolor,* IIIBr 2 series being developed on the outer side of each IIBr series in 2, 1, 1, 2 order.

P_3 is as large as and resembles P_2 instead of being considerably smaller as is usually the case in *N. multicolor.*

Locality.—*Albatross* station 5153; Philippine Islands; Sulu (Joló) Archipelago, Tawi Tawi group; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5°18′10″ N., long. 120°02′55″ E.); 89 meters; coral sand and shells; February 19, 1908 [A. H. Clark, 1908] (6, U. S. N. M., 25446, 35560).

Remarks.—Only the six original specimens of this species are known.

NEOMETRA SPINOSISSIMA (A. H. Clark)

PLATE 39, FIGURE 203

[See also vol. 1, pt. 2, figs. 506, 507 (pinnule tip), p. 276; fig. 761 (side- and covering-plates), p. 353.]

Calometra spinosissima A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 79 (description Andaman Islands).

Calometra spinossima A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544 (affinities; cirri compared with those of *C. alecto*).

Neometra spinosissima A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 181 (synonymy; detailed description; Andaman Is.), fig. 30, p. 182; Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 128 (affinities), p. 130 (characters; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 133 (in key; range).—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 96 (characters of the lower pinnules); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnostic features.—This is the largest species in the genus, the arms being 130 mm. in length; the cirri are slender and short, reaching less than one-fifth of the length of the arms, with 42–55 segments; and there are 20 arms.

Description.—The centrodorsal is discoidal, moderately thick, with the bare polar area flat and 3 mm. in diameter. The cirrus sockets are arranged in a single crowded marginal row.

The cirri are XI, 42–55, 25 mm. long, moderately slender. The first segment is about three times as broad as long, and those following slowly increase in length to the sixth or seventh, which is nearly as long as broad. The succeeding segments are similar to the twelfth or fifteenth, from that point onward gradually decreasing in length so that the segments in the terminal portion are twice as broad as long. At about the fifteenth a low sharp dorsal keel makes its appearance, at first in the distal portion only but soon along the entire dorsal surface, which very slowly increases in height, becoming very prominent on the short terminal segments though never exceeding more than one quarter of their width in height. The opposing spine and terminal claw are as in *N. multicolor.*

The ends of the basal rays are visible as small tubercles or small rhombic areas in the interradial angles, but as they are not raised above the general surface of the radials they are not especially obvious.

The radials are short in the median line but extend upward in the interradial angles in the form of an equilateral triangle the rounded apex of which entirely separates the bases of the IBr_1. The IBr_1 are slightly trapezoidal, about two and one-half times as broad as long, with the ventrolateral margins very thin. The IBr_2 (axillaries) are pentagonal, as long as, or only very slightly shorter than, broad, with the lateral edges nearly or quite as long as those of the IBr_2, slightly constricted just below the lateral angles. The IIBr series are 2, the $IIBr_1$ united in the proximal two thirds, diverging at approximately a right angle distally.

The 19 arms are 130 mm. long, resembling in the main those of *N. multicolor.* The first brachials are wedge-shaped, about as long exteriorly as broad distally, interiorly united for almost their entire length. The second brachials are similar but swollen exteriorly to form an attachment for the greatly enlarged lower segments of P_1. The first syzygial pair (composed of brachials 3+4) is from slightly longer than broad to half again as long as broad and is slightly constricted centrally. The next three or four brachials are wedge-shaped, progressively more and more oblique, somewhat longer than broad, those following becoming triangular, as long as broad with the exterior side somewhat convex, and wedge-shaped terminally. At about the seventh brachial the distal edge becomes projecting and overlapping and armed with fine spines, this projection on the side toward the longer lateral edge of the brachials ending abruptly in a more or less pronounced sharp point or spine so that the arms appear to have dorsally a double row of more or less marked short overlapping spines. Distally these spines gradually move nearer and nearer the median line, at the same time becoming rounded carinate, finally dying away distally.

Syzygies occur between brachials 3+4, again from between brachials 10+11, to between brachials 12+13, and distally at intervals of 3 (more rarely 2 or 4) muscular articulations.

P_1 is 10 mm. long, very slender and weak, composed of 35 segments of which the first is proportionately greatly enlarged, twice as broad as long, with a strong carinate process, the second is much shorter, strongly trapezoidal, and the remainder are very small and about as long as broad. P_2 is somewhat longer, but stiff and spine-like with elongated segments like P_3. P_3 is 20 mm. long, not especially stout but very stiff, with about 20 segments of which the first is about twice as broad as long, slightly carinate, the second is trapezoidal, about as broad distally as the proximal length, the third is half again as long as broad, the fourth is over twice as long as broad, and the remainder are from two and one-half to three times as long as broad and even longer distally. The segments have slightly projecting and spinous distal ends, this feature increasing in intensity distally. P_4 is similar to P_3 and of the same length. The pinnules following decrease to 12 mm. on P_6, then become somewhat stouter, and more slender again distally, though remaining of the same length. The segments in the distal portion of all the pinnules have prominent, somewhat expanded, spinous distal ends. The pinnules on the outermost arms of each postradial series appear to be considerably longer than those on the inner arms.

Side- and covering-plates are very highly developed.

The disk is unknown.

Locality.—*Investigator* station 236a; northeast of North Andaman Island (lat. 14° 08′ N., long. 93°08′ E.); 302 meters; April 11, 1898 [A. H. Clark, 1909, 1911, 1912, 1914, 1918, Gislén, 1922, 1934] (1, I. M.).

History.—This species was described under the name *Calometra spinosissima* in 1909 from a single specimen dredged by the Royal Indian Marine Survey steamer *Investigator* off the Andaman Islands in 1898. In 1911 the cirri were compared with those of the new species *Calometra alecto;* but the name was misspelled *spinossima.* In 1912 it was redescribed and figured under the name of *Neometra spinosissima.* Its characters and affinities were discussed and the habitat given in 1914, and it was included in a key to the species of the genus *Neometra,* with the range, in 1918. In 1922 and again in 1934 Prof. Torsten Gislén discussed various features of its structure.

NEOMETRA CONAMINIS A. H. Clark

PLATE 36, FIGURE 191

[See also vol. 1, pt. 2, fig. 838 (side- and covering-plates), p. 405.]

Neometra conaminis ALEXANDER, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 108 (*nomen nudum:* between Fremantle and Geraldton).—A. H. CLARK, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 115 (discovery; faunal affinities), p. 128 (systematic affinities), p. 129 (between Fremantle and Geraldton, 80–120 fms.; description of the type specimen; comparisons), p. 130 (characters; range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 225 and following (distribution); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 133 (in key; range).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 55 (notes).

Diagnostic features.—The 20 arms are not over 90 mm. in length; the arms are broader and more rounded dorsally than those of *N. alecto,* with the distal edges of the brachials less produced; the cirri are less than one-third of the arm length, stouter than those of *N. alecto,* with 39–46 segments of which the distal edges are not modified; the first segment of P_1 is not produced dorsally and is only slightly broader than the second; and the first segment of P_2 is without a dorsal process.

Description.—The centrodorsal is of medium size, discoidal, with the flat dorsal pole 4.5 mm. in diameter. The cirrus sockets are arranged in a single more or less irregular marginal row, rarely with traces of a second

The cirri are XIV–XIX, 40–45, 25 mm. long. The longer earlier segments are from half again as broad as long to nearly as long as broad, and the shorter distal segments are about three times as broad as the median length, becoming longer again terminally. On the sixth or seventh segment the median dorsal portion of the distal edge becomes slightly prominent, this prominence gradually rising in height and slowly extending itself proximally until on about the tenth there results a narrow median keel running the whole length of the dorsal surface. On the succeeding segments this gradually increases in height, becoming the high, thin, median carination characteristic of the outer cirrus segments of all the species of this genus. The ventral surface of the cirri is rather narrowly rounded so that in cross section the cirri are seen to approach a rhombic shape, but with the four angles of the rhombic outline very broadly rounded. The cirri taper slowly and gradually throughout their whole length and are not particularly stout.

The radials are concealed in the median line but extend upward in the interradial angles of the calyx in the form of triangular processes of which the sides, which are about as long as the base, are concave and the apices are truncated, entirely, though not very widely, separating the bases of the IBr_1. The IBr_1 are very slightly trapezoidal, almost oblong, from three to four times as broad as long; the ventrolateral edges, though sharp, are only very slightly, if at all, produced. These ossicles occasionally bear an obscure low median keel. The IBr_2 (axillaries) are broadly pentagonal, slightly broader than long, with the lateral edges usually slightly shorter than those of the IBr_1. The IIBr series are 2.

The 20 arms are from 85 to 90 mm. long and resemble those of the other species of the genus.

P_1 is 9 mm. long with 25–30 segments of which the first two are greatly enlarged and the remainder are slightly longer than broad. P_2 is 12 mm. long with 16–17 segments which after the third become much elongated, those in the outer part of the pinnule having produced distal edges bearing prominent spines at the prismatic angles; the pinnule is stiff and spinelike. P_3 is 15–17 mm. long with 16–18 segments and resembles P_2 but is proportionately larger. P_4 is 17 mm. long with 18 segments and is similar to P_3. P_5 is 12 mm. long with 15 segments and is similar to the pinnules preceding. P_6 is 10 mm. long with 14 segments. The distal pinnules are about 11 mm. long.

The side- and covering-plates do not differ essentially from those of *N. alecto*.

Locality.—Between Fremantle and Geraldton, Western Australia; 146–219 meters; Australian Federal Fisheries Investigation steamer *Endeavour* [Alexander, 1914; A. H. Clark, 1914, 1915, 1918; Gislén, 1934] (4, U.S.N.M., 35559; W. A. M.).

History.—This species was described in 1914 from four specimens dredged by the *Endeavour* off Western Australia. Its distribution was given in 1915, and in 1918 it was included in a key to the species of *Neometra*, with the habitat. Prof. Torsten Gislén in 1934 discussed its type of arms branching.

NEOMETRA ALECTO (A. H. Clark)

[See vol. 1, pt. 2, figs. 835–837 (side- and covering-plates), p. 405.]

Calometra alecto A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 544 (description; *Albatross* stations 5414, 5356, 5413; affinities).

Neometra alecto A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 184 (synonymy; locality); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 128 (affinities), p. 130 (characters; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 133 (in key; range), p. 137 (notes; station 305), p. 276 (listed).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 96 (characters of the lower pinnules).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 646 (Rotti Strait; 100 fathoms).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 47, p. 11, 1934 (east of Hainan).

Diagnostic features.—In this species the 15–20 very narrow arms are from 60 mm. to 70 mm. in length, and have the distal ends of the brachials rather strongly produced; the cirri are rather slender, more than one-third of the arm length, composed of 39–46 segments of which the distal ends are prominent; the first segment of P_1 bears a high rounded dorsal process and is from half again to twice as broad as the second; and the first segment of P_2 has a prominent high dorsal process.

Description.—The centrodorsal is discoidal, moderately thick, with the bare polar area flat, 4 mm. in diameter. The cirrus sockets are arranged in a single slightly irregular marginal row.

The cirri are IX–XV, 39–46, from 25 mm. to 30 mm. long, resembling those of *N. spinosissima* but somewhat more slender, especially distally; there is no ventral carination as in *N. acanthaster.* The first segment is very short, and the following gradually increase in length to the fifth, which is nearly or quite as long as broad; those succeeding up to the twelfth are similar, from which point the segments gradually decrease in length those in the terminal third of the cirri being twice as broad as long. After the fifth or sixth the distal edge of the segments on the dorsal side becomes prominent this prominence gradually narrowing, becoming higher, and moving anteriorly, while at the same time the dorsal surface of the segments becomes strongly carinate so that the short distal segments possess prominent, though small and broadly rounded dorsal spines scarcely reaching in height one-quarter the width of the segments which bear them. In the longer proximal segments there is more or less eversion of the ventral distal edge. The cirri are moderately stout basally, but taper slightly, becoming rather slender distally.

The disk, calyx, and arm bases resemble those of *N. multicolor.* The division series and first two brachials have a slight rounded median carination.

The 15–20 arms are from 60 mm. to 70 mm. in length, and resemble those of *N. multicolor.* The brachials have moderately produced distal borders.

P_1 is 7 mm. long, slender and weak, composed of 25 segments of which the first is greatly enlarged. P_2 is stiff and spinelike, 10 mm. long. P_3 is similar, 12 mm. long. P_4 is similar, 10 mm. long. P_5 is 9 mm. long. P_6 is 8 mm. long. P_7 and the following pinnules are 6 mm. long. The distal pinnules are 8 mm. long.

Notes.—Of the specimens obtained at *Albatross* station 5414, 2, both young, had 13 arms, 1 had 15, 2 had 16, 3 had 17, 1 had 18, 3 had 19, and 5 had 20; one of the specimens was small and much mutilated. An example from *Albatross* station 5356 had 19 arms, and 2 from station 5413 had 17 and 18 arms respectively.

The specimen from *Siboga* station 305 had apparently 20 arms, there being 12 on the 3 rays preserved, about 70 mm. long. The cirri are XVII; one cirrus not quite of full size with 39 segments remains.

Localities.—*Siboga* station 305; midchannel of Solor Strait, off Kampong Menanga; 113 meters; stony bottom; February 8, 1899 [A. H. Clark, 1918] (1. Amsterdam Mus.).

Rotti Strait, between Rotti and southwestern Timor; 183 meters; cable repair ship *The Cable,* Eastern and Associated Telegraph Co.; from the Banjuwangi-Darwin No. 2 cable [A. H. Clark, 1929] (3, B. M.).

Albatross station 5356; North Balabac Strait; Balabac light bearing S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long. 117° 18′ 45″ E.); 106 meters; January 5, 1909 [A. H. Clark, 1911] (1, U.S.N.M. 35417).

Albatross station 5355; North Balabac Strait; Balabac light bearing S. 61° W., 16.6 miles distant (lat. 8° 08′ 10″ N., long. 117° 19′ 15″ E.); 80 meters; coral and sand; January 5, 1909 (disk, U.S.N.M., 35991).

Albatross station 5413; between Cebu and Bohol; Lauis Point light bearing N. 68° W., 10 miles distant (lat. 10° 10′ 35″ N., long. 124° 03′ 15″ E.); 77 meters; March 24, 1909 [A. H. Clark, 1911] (2, U.S.N.M., 35414, 35430).

Albatross station 5414; between Cebu and Bohol; Lauis Point light bearing N. 67° W., 9.5 miles distant (lat. 10° 10′ 40″ N., long. 124° 02′ 45″ E.); 77 meters; March 24, 1909 [A. H. Clark, 1911] (16, U.S.N.M., 27494, 35413, 35415, 35416, 35429, 34531–35436, 35473, 35522).

China Sea, east of Hainan (lat. 19° 18′ N., long. 112° 14′ E.); 208 meters; cable repair ship *The Cable*, Eastern and Associated Telegraph Co. [A. H. Clark, 1934] (2, Raffles Mus.).

Geographical range.—From the Lesser Sunda Islands to the Philippines and Hainan.

Bathymetrical range.—From 77 to 208 meters; the average of 7 records is 121 meters.

History.—This species was described in 1911 as *Calometra alecto* from a specimen from *Albatross* station 5414. Eighteen additional specimens were secured at this station, and at the same time one was recorded from station 5356 and two more from station 5413. It was stated that this species belongs to that group in the genus *Calometra* that includes *C. multicolor*, *C. acanthaster*, and *C. spinossima* (*=spinosissima*).

In 1912 upon the establishment of the genus *Neometra* in my memoir on the crinoids of the Indian Ocean this species was transferred to it, and the synonymy and range of *Neometra alecto* were given. The affinities, characters, and range of *Neometra alecto* were given in 1914.

In 1918 a specimen was recorded from *Siboga* station 305, and notes on it were given. In 1922 Prof. Torsten Gislén discussed the characters of the lower pinnules, and in 1929 I recorded three much broken specimens from Rotti Strait that had been found on a cable brought to the surface from a depth of 183 meters by the cable repair ship *The Cable* and presented to the British Museum by the Eastern and Associated Telegraph Co. In 1934 Professor Gislén discussed the arm structure, and in the same year I recorded two more specimens that had been collected by *The Cable* and presented to the Raffles Museum in Singapore.

NEOMETRA MULTICOLOR (A. H. Clark)

PLATE 36, FIGURE 192

[See also vol. 1, pt. 1, fig. 19 (disk), p. 67; fig. 263 (ventral view of centrodorsal), p. 257; fig. 481 (dorsal view of radial pentagon), p. 363; pt. 2, figs. 65, 66 (radial pentagon), p. 43; fig. 314 (proximal pinnules), p. 227; figs. 336, 339 (middle and distal pinnules), p. 229.]

Antedon discoidea (part) H. L. CLARK, *in* McClendon, Bull. Amer. Mus. Nat. Hist., vol. 23, 1906, pp. 120, 125, 126 (Suruga Gulf and Sagami Bay; myzostomes).—BOULENGER, British Antarctic ("Terra Nova") Exped., 1910, Nat. Hist. Rep., Zool., vol. 2, No. 6, 1916, p. 136 (host of *Myzostomum cysticolum*).

Antedon multicolor A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 130 (description; *Albatross* station 4894), p. 152 (comparison of radials with those of *A. thetis*); vol. 34, 1908, p. 484.

Antedon thetis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 151 (description; *Albatross* station 3744); vol. 34, 1908, p. 497.—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 95.

Calometra multicolor A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 313 (various localities in Sagami Bay and Tokyo Gulf); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 224 (compared with *C. acanthaster*); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 79 (compared with *C. spinosissima*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 366 (radials compared with those of *Comatilia*); vol. 39, 1911, p. 544 (belongs to the same group as *acanthaster*, *spinosissima*, and *alecto*), p. 545 (disk, calyx, and arm bases compared with those of *C. alecto*).

Calometra thetis A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed).

Neometra multicolor A. H. Clark, Zool. Anz., vol. 39, 1912, No. 11/12, p. 422 (arms compared with those of *N. sibogae*), p. 423 (brachials compared with those of *Calometra diana*); Smithsonian Misc. Coll., vol. 60, No. 10, 1912, p. 29 (Okinose; 55 fms.); Crinoids of the Indian Ocean, 1912, p. 183 (synonymy; range); Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 128 (position within the genus), p. 130 (characters; range); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 133 (in key; range); Smithsonian Mis. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 5 (disk).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 94 (Bock's station 12; characters of the specimens), figs. 75, *a*, *b*, 76, p. 88 (pinnules); Zool. Bidrag Uppsala, vol. 9, 1924, p. 22 (Mortensen's station 24, southern Japan; development of distal pinnules into arms), p. 79 (non-muscular articulations), fig. 77, p. 81 (syzygial face), fig. 104, p. 87 (synarthrial face), figs. 168–172, p. 98 (pinnule articulations); Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p, 2 (occurrence of IIBr series; stations 9, 13, 20, 24, 25; 108–900 meters), p. 30 (same stations; notes), pp. 68, 69 (listed); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Neometra multicor Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 22 (editorial error).

Diagnostic features.—The 20 arms are never over 85 mm. and rarely over 65 mm. in length; there are 35 cirrus segments of which the distal bear a single median keel.

Description.—The centrodorsal is thick discoidal with the large bare polar area flat or slightly convex. The cirrus sockets are arranged in a single marginal row.

The cirri are XV, 35, about 20 mm. long. The segments increase in length to the sixth, which is about as long as broad, then remain uniform to about the fifteenth, after which they gradually decrease in length so that the distal segments are about twice as broad as long, becoming again about as long as broad on the terminal 4 or 5. The distal ends of the segments project somewhat dorsally, this projection increasing in the distal half of the cirri where it forms broad, rather blunt and rounded, though prominent, dorsal spines. The opposing spine is triangular, blunt, with the apex terminally situated, arising from the entire dorsal surface of the penultimate segment, and in height equal to about half the width of that segment. The terminal claw is stout, blunt, but little curved, and less than the penultimate segment in length.

The ends of the basal rays are usually not visible in the angles of the calyx, but they sometimes appear as small rounded tubercles.

The radials are short in the median line, sometimes scarcely projecting beyond the rim of the centrodorsal; but in the interradial angles they form large triangles the apices of which are strongly produced anteriorly, entirely and usually widely separating the bases of the IBr$_1$. Occasionally, though somewhat rarely, the anterior prolongation of the triangle formed by the radials in the interradial angles does not quite reach to the bases of the IBr$_1$ in one or two of the interradial areas. The IBr$_1$ are trapezoidal, narrower distally than proximally, about twice as broad as the distal width; the proximal corners are somewhat truncated by the interradial prolongations of the radials. The IBr$_2$ (axillaries) are pentagonal, about half again as broad as long. Both ossicles are perfectly smooth and evenly rounded dorsally, rising to a low synarthrial tubercle on the line of the articulation between them. Their lateral borders are smooth and straight, never produced, so that the IBr series are remarkable in being very widely separated. The IIBr series are 2, resembling the IBr series though with the component ossicles relatively slightly longer; the $IIBr_1$ are interiorly united for their entire length. The IIIBr series are 2 and resemble the IIBr series. They are rarely present, and occur only on the outer side of the IIBr series.

Arms 20 in number (sometimes a few less), from 60 mm. to 85 mm. (usually between 60 mm. and 65 mm.) in length. The first brachials are wedge-shaped, not quite twice as broad as the interior length, united interiorly. The second brachials are of about the same shape and size, with the outer side convex. The first syzygial pair (composed of brachials 3+4) is somewhat longer than broad, more rarely about as long as broad, with the ends parallel and more or less constricted centrally. The fifth brachial resembles the second. The following brachials rapidly become more obliquely wedge-shaped and after the seventh triangular, as long as broad, with the long outer side concave. Distally the brachials become wedge-shaped again; the terminal 6 to 8 segments are very small and short, falling about 3 mm. or 4 mm. short of the tips of the terminal pinnules. The brachials are smooth and do not overlap.

Syzygies occur between brachials 3+4 (exceptionally 4+5), again between brachials 11+12 to 13+14, and distally at intervals of 3, more rarely 4, muscular articulations.

P_1 is about 7 mm. long, very slender, weak and flexible, composed of 30–35 segments of which the first is greatly enlarged, rather over twice as broad as long, rounded oblong with the distal edge concave, the second is also enlarged, about half as broad as the first but nearly of the same length, and those following are very small and about as long as broad. P_2 is nearly or quite twice as long as P_1, stout, stiff and spinelike, with the first segment enlarged like the corresponding segment of P_1 though not quite so much so, the second trapezoidal, rather longer than the first, and the third and following elongate. The third segment is about half again as long as broad and the remainder are about twice as long as broad, or even slightly longer distally. The segments in the outer third or half of the pinnule have slightly overlapping spinous distal ends. There are 20 segments in all. While P_1 is rounded triangular in cross section, P_2 and the following pinnules are strongly and sharply prismatic. P_3 resembles P_2 but is usually shorter, intermediate in length between P_2 and P_1; sometimes it is as long as, or even longer and stouter than, P_2. The following pinnules decrease in length very gradually to P_7 or P_8, which is about 5 mm. long, then increase again very gradually to 6 mm. or 7 mm. distally. The first 2 segments of P_3 are but little expanded, those of P_4 and the following pinnules being the same as the first 2 segments of the distal pinnules. The genital pinnules are not expanded, nor are their terminal segments especially different from the others. The distal pinnules have the first segment somewhat wedge-shaped, convex proximally and anteriorly and concave distally, the second trapezoidal, about as long as the distal width, and the remainder twice as long as broad except for the terminal, which decrease abruptly in width and have overlapping and spinous ends.

Notes.—The specimens collected by the *Albatross* present the following features; station 3744, a 10-armed young; station 3746, 3 small specimens with arms 35 mm. long, 1 10-armed and 2 12-armed; 1 is white with broad purple bands on the arms; station 4935, a 10-armed young; station 4936, 1 of the 3 specimens is white with broad purple bands on the arms; station 3764, a 14-armed young, three rays with 2 arms each, and two rays with 4 arms each.

The specimens collected by Alan Owston's yacht *Golden Hind* show the following features; lat. 35° 08′ N., long. 139° 42′ E., 55 meters; of the 3 large specimens 1 is white with broad purple bands on the arms; lat. 34° 59′ N., long. 139° 34′ E., 110 meters; of the 2 specimens 1 is large, the other very small; lat. 34° 59′ N., long. 139° 34′ E., 110 meters; 1 is very large with the arms 85 mm. in length, and 2 are small with the arms 30 mm. long; the largest specimen has 11 arms, the 2 smallest 10; lat. 35° 02′ N., long. 138° 50′ E., 100 meters; 1 small 10-armed specimen; lat. 35° 08′ N., long. 139° 42′ E., 55 meters; of the 4 specimens 3 are large and 1 smaller; lat. 35° 11′ N., long. 139° 45′ E., 91 meters; 3 large specimens; off Okinose, 100 meters; 2 large specimens; off Sunosaki, 100 meters; 1 very small specimen; Uraga Channel, 46 meters; 1 large specimen.

The specimen collected by Dr. Haberer off Fukuura had about 15 arms 80 mm. long. That collected by Professor Doflein near Misaki in 20 meters had 17 arms about 55 mm. long, and that collected by the same gentleman on the Okinose Bank in 600 meters was a small 10-armed individual. Of the 2 specimens collected by Professor Doflein on the Okinose Bank in 250 meters 1 had 14 arms about 70 mm. long, and the other was small with 16 arms about 40 mm. long.

In one of the 2 specimens from Dr. Sixten Bock's station 12, as described by Gislén, the centrodorsal is slightly arched and dorsally flattened, 1.5 mm. in diameter. The cirri are XII, 27–30, 11 mm. long, arranged in a narrow row; the first segment is short, the second is about as long as broad, the third is a little longer, and the fourth and following are half again as long as broad, distally becoming shorter again. The distal portion of the cirrus segments from the fifth onward is somewhat everted. The dorsal spines are single, and are developed from about the fifteenth segment outward. The opposing spine equals half the width of the penultimate segment in height. The terminal claw is curved, and shorter than the penultimate segment. The radials are four times as broad as long, and are interradially produced into processes which separate the bases of the IBr_1; these last are three times as broad as long, widely separated laterally, provided with slight lateral prominences and, together with the preceding and succeeding ossicles, showing an inconspicuous mediodorsal elevation. The IBr_2 (axillaries) are one-third again as broad as long, and are without a lateral flange. The IIBr series are 2. The brachials immediately following these axillaries are interiorly united. The 12 arms are 30 mm. long. The second brachial is exteriorly twice as long as interiorly. Gislén gives the syzygies on one arm as occurring between brachials 3+4, 12+13, 17+18, 21+22, thence at intervals of 3 or 4 muscular articulations. P_1 is 4.5 mm. long with 19 segments of which the first 2 are greatly enlarged, the first three times as broad as long with an extension which is broader whan the width of the segment, the second twice as broad as long with a smaller extension, and those following half again as long as broad and rather smooth, though prismatic. P_2 is 7 mm. long with 17 segments, stouter than P_1; the first 2 segments resemble those of P_1, but are less enlarged; the third and following segments are from 3 to 4 times as long as broad, the distal becoming shorter again with spinous distal ends. P_3 is 5 mm. long with 10 segments of which only the first carries a winglike process. This winglike process on the first pinnule segment becomes less and less conspicuous out to the tenth or fifteenth pinnules. The distal pinnules are 7 mm. long with 15 segments of which the first and second are slightly enlarged, from twice as broad as long to as long as broad, and the third and following are from 2 to two and one-half times as long as broad; the 4 terminal segments are shorter and more slender with spinous distal ends.

In the other specimen the cirri are X, 28–31, about 11 mm. long; a dorsal spine is developed from the twelfth segment onward. The radials are visible interradially. The carination on the elements of the IBr series is very slight and indistinct. The 10 arms are 32 mm. in length. Syzygies occur between brachials 3+4, 9+10 and 13+14, thence distally at intervals of 3 muscular articulations. P_1 is 5 mm. long with 21 segments. P_2 is 6 mm. long with 14+ segments. P_3 is 4.7 mm. long with 13 segments. The distal pinnules are 6 mm. long with 13+ segments.

Parasite.—Gislén notes that on the first of the two individuals just described there was a parasitic *Eulima*, probably a *Sabinella* (or *Melanella*) similar to, if not identical with, that which I found on an example of *Stenometra diadema* from the same region (see vol. 1, pt. 2, p. 649).

Localities.—*Albatross* station 4894; Eastern Sea, southwest of the Goto Islands; Ose Saki light bearing N. 41° E., 5 miles distant (lat. 32°33′00″ N., long. 128°32′10″ E.); 174 meters; temperature 13.28° C.; green sand, broken shells and pebbles; August 9, 1906 [A. H. Clark, 1907] (2, U.S.N.M., 22619, 36289).

Dr. Sixten Bock's Expedition to Japan station 12; the coral bank, Goto Islands; 164 meters; May 15, 1914 [Gislén, 1922].

Albatross station 4935; Eastern Sea off Kagoshima Gulf; Sata Misaki light bearing N. 58° E., 4.5 miles distant (lat. 30°57′20″ N., long. 130°35′10″ E.); 188 meters; temperature 15.89° C.; stones; August 16, 1906 (1,U.S.N.M., 35444).

Albatross station 4936; Eastern Sea off Kagoshima Gulf; Sata Misaki light bearing N. 21° E., 5.7 miles distant (lat. 30°54′40″ N., long. 130°37′30″ E.); 188 meters; temperature 15.89° C.; stones; August 16, 1906 (3+, U.S.N.M., 35449, 35456, 36169, 36189).

Sagami Bay, Japan (lat. 35°04′ N., long. 138°47′ E.); 201 meters; Alan Owston, August 6, 1902 [A. H. Clark, 1908] (1).

Sagami Bay (lat. 34°58′ N., long. 138°45′ E.); 141 meters; Alan Owston, August 13, 1902 [A. H. Clark, 1908] (1, U.S.N.M., 35459).

Sagami Bay (lat. 35°02′ N., long. 138°50′ E.); 100 meters; Alan Owston [A. H. Clark, 1908] (1, U.S.N.M., 35453).

Sagami Bay (lat. 34°59′ N., long. 139°34′ E.); 110 meters; Alan Owston, April 17, 1902 [A. H. Clark, 1908] (6, U.S.N.M., 35457).

Sagami Bay (lat. 34°59′ N., long. 139°34′ E.); 100 meters; Alan Owston, April 23, 1902 [A. H. Clark, 1908] (2, U.S.N.M., 35463).

Sagami Bay (lat. 35°03′ N., long. 139°42′ E.); 55 meters; Alan Owston, October 12, 1902 [A. H. Clark, 1908] (1).

Sagami Bay (lat. 35° 08′ N., long. 139° 42′ E.); 55 meters; Alan Owston, October 12, 1902 [A. H. Clark, 1908] (3, U.S.N.M., 35446, 35447, 35467).

Sagami Bay (lat. 35° 09′ N., long. 139° 42′ E.); 55–73 meters; Alan Owston, May 4, 1902 [A. H. Clark, 1908] (1, U.S.N.M., 35462).

Sagami Bay (lat. 35° 08′ N., long. 139° 42′ E.); 55 meters; Alan Owston, May 25, 1902 [A. H. Clark, 1908] (4, U.S.N.M., 35445, 35460, 35466).

Sagami Bay (lat. 35° 11′ N., long. 139° 45′ E.); 91 meters; Alan Owston, June 30, 1901 [A. H. Clark, 1908] (3, U.S.N.M., 35471).

Sagami Bay (lat. 35° 13′ N., long. 139° 45′ E.); 73 meters; Alan Owston, November 9, 1902 [A. H. Clark, 1908] (1, U.S.N.M., 35461).

Sagami Bay; either lat. 34° 59′ N., long. 139° 33′ E., 110 meters, April 20, 1902; or lat. 35° 06′ N., long. 139° 42′ E., 55 meters, April 24, 1902 [A. H. Clark, 1908] (13, U.S.N.M., 35952).

Albatross station 3746; Sagami Bay; Sunosaki bearing N. 87° E., 8.5 miles distant 89 meters; gray sand and pebbles; May 19, 1900 [McClendon, 1906] (3, U.S.N.M., 35469).

Albatross station 3744; Sagami Bay; Sunosaki bearing E., 8.83 miles distant; 84 meters; fine yellow gravel; May 19, 1900 [McClendon, 1906; A. H. Clark, 1907] (1, U.S.N.M., 22654).

Albatross station 3758; Sagami Bay; Sunosaki bearing S. 55° E., 2.1 miles distant; 95–133 meters; blue clay and rock; May 22, 1900 [McClendon, 1906] (1, U.S.N.M., 35450).

Albatross station 3764; Sagami Bay; Sunosaki bearing S. 64° E., 2.8 miles distant; 80–91 meters; fine gravel and broken shells; May 22, 1900 [McClendon, 1906] (10, U.S.N.M., 35448; M. C. Z., 51,265).

Sagami Bay; off Sunosaki, 100 meters; Alan Owston, May 8, 1899 [A. H. Clark, 1908] (1, U.S.N.M., 35454).

Albatross station 3729; Sagami Bay; Omai Zaki light bearing N. 17° E., 12.7 miles distant; 62 meters; mud and gravel; May 16, 1900 (2, M. C. Z., 264).

Albatross station 3735; Sagami Bay; Omai Zaki light bearing N. 15° E., 11.4 miles distant; 66 meters; coarse gray volcanic sand and broken shells; May 16, 1900 [McClendon, 1906] (2, U.S.N.M., 35470).

Sagami Bay; off Fukuura; Doctor Haberer, February 10–20, 1903 (1, Munich Mus.).

Sagami Bay; off Okinose; 100 meters; Alan Owston, October 27, 1901 [A. H. Clark, 1908, 1912] (5, U.S.N.M., 35464, 35468; H. M.).

Okinose Bank; 250 meters; Prof. Franz Doflein (2, Munich Mus.).

Okinose Bank; 600 meters; Prof. Franz Doflein (1, Munich Mus.).

Near Misaki; 20 meters; Prof. Franz Doflein, October 14, 1904 (1, Munich Mus.).

Uraga Channel, at the entrance to Tokyo Gulf; 46 meters; Alan Owston, May 26, 1901 [A. H. Clark, 1908] (1, U.S.N.M., 35465).

Uraga Channel, 36–55 meters; Alan Owston, April 21, 1901 [A. H. Clark, 1908] (1, U.S.N.M., 35458).

Uraga Channel, 55 meters; Alan Owston, May 17, 1901 [A. H. Clark, 1908] (2, U.S.N.M., 35455).

Geographical range.—Southern Japan eastward to Tokyo Bay.

Bathymetrical range.—From 20 to 600 meters; the average of 31 records is 114 meters.

Thermal range.—From 13.28° C. to 15.89° C.; the average of 3 records is 15.00° C.

Remarks.—This is a rather common species in suitable localities on the coast of southern Japan where it has been collected by the *Albatross*, by Alan Owston in his yacht *Golden Hind*, by Prof. Franz Doflein, by Dr. Haberer, by Dr. Th. Mortensen, and by Dr. Sixten Bock, as well as by several Japanese naturalists.

For an account of the association between this and the 2 other Japanese species of this family, *Pectinometra flavopurpurea* and *Calometra callista*, see page 383.

Genus PECTINOMETRA A. H. Clark

Antedon (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 134, and following authors.

Calometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363.

Pectinometra A. H. Clark, Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 129 (*nomen nudum;* characteristic of the Japanese fauna; significance); Crinoids of the Indian Ocean, 1912, p. 17 (significance of the conditions in this genus in southern Japan), p. 23 (range), p. 58 (in key), p. 185 (diagnosis; a genus of Calometridae; genotype *Antedon flavopurpurea* A. H. Clark, 1907); Die Crinoiden der Antarktis, 1915, p. 125 (certain species show the characteristic features of *Anthometra adriani);* Unstalked crinoids of the *Siboga*-Exped., 1918, p. 138 (key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 96, 97; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Pectiometra Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 54.

Diagnosis.—A genus of Calometridae in which the arms are 15–20 in number, all the division series being 2; the radials are not extended upward interradially; the division series are in apposition with those on either side directly or through more or less irregularly developed lateral extensions; the proximal portion of the animal is compact, the sides in profile making a relatively small angle with the dorsoventral axis; the longer oral pinnules are markedly longer than the shorter genital pinnules; and the segments of the genital pinnules are more or less expanded.

Geographical range.—From the Andaman Islands to Celebes and the Philippines, and northward to southern Japan as far east as Tokyo Bay.

Bathymetrical range.—From 155 (?115) to 450 meters.

Thermal range.—From 8.67° C. to 17.22° C.

History.—The name *Pectinometra* first appeared as a *nomen nudum* in a list of comatulid genera characteristic of the waters of southern Japan published in 1911. In 1912 the genus *Pectinometra* was formally diagnosed, and *Antedon flavopurpurea* A. H. Clark, 1907, was given as the genotype. There has been no change in the status of the genus since that time.

KEY TO THE SPECIES IN THE GENUS PECTINOMETRA

- a^1. Ossicles of the division series and first 2 brachials with no trace of median carination, rugose on the dorsal surface and with finely crenulate edges which are not everted; 15–20 arms; cirri with 26–40 (usually 34–36) segments (Philippine Islands; 177–201 meters)_ **carduum** (p. 376.)
- a^2. Ossicles of the IBr series with a prominent high median keel; a similar but much less developed (sometimes obsolete) keel on the ossicles of the IIBr series and the first 2 brachials; the edges of the ossicles of the division series may be everted, but are never crenulate; usually 20 arms.
  - b^1. Cirri with 41–48 segments; keel on the ossicles of the IBr series very high and prominent, especially proximally; edges of the ossicles of the division series only slightly or not at all everted (Celebes to the Andaman Islands; 302–450 meters)__________ **magnifica** (p. 377.)

b^2. Cirri with 30 segments; keel on the ossicles of the IBr series lower and more uniform in height; edges of the ossicles of the division series prominently everted (southern Japan; 155 [?115]–365 meters) .... **flavopurpurea** (p. 379.)

PECTINOMETRA CARDUUM (A. H. Clark)

[See vol. 1, pt. 2, fig. 202 (lateral view), p. 134.]

Calometra carduum A. H. Clark, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 222 (description; *Albatross* station 5167); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 400 (*Albatross* station 5166).

Pectinometra carduum A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 188 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 138 (in key; range).

Diagnostic features.—The ossicles of the division series and the first two brachials have no trace of a median carination: they are coarsely rugose on the dorsal surface, and their sides, which are closely appressed against those of their neighbors, are finely crenulate or dentate and not everted; there are 15–20 arms, and the cirri have 26–40 segments.

Description.—The centrodorsal is hemispherical or thick discoidal with a large convex polar area bare. The cirrus sockets are arranged in two closely crowded marginal rows.

The cirri are X–XV, 26–40 (usually 34–36), from 20 mm. to 25 mm. in length. The first segment is short, the following become progressively longer to the fourth or fifth, which is about as long as broad, and remaining similar to about the end of the proximal third of the cirri, after which the length gradually decreases. From the twelfth or fourteenth segment onward prominent blunt dorsal spines are developed. The opposing spine is rather small, arising from the entire dorsal surface of the penultimate segment, with the apex terminal.

The radials are usually concealed by the centrodorsal, but are sometimes partially visible in the interradial angles. The IBr_1 are short and bandlike, in lateral apposition, with the dorsal surface coarsely rugose and the edges crenulate or more or less dentate. The IBr_2 (axillaries) are triangular, about twice as broad as long, with the dorsal surface rugose and the edges finely crenulate. The IIBr series are 2, resembling the IBr series and, like the latter, in close lateral apposition.

The 15–20 arms are 60 mm. long. The first brachials are wedge-shaped, longer exteriorly than interiorly, in close apposition interiorly, with the edges sharply crenulate or dentate. The second brachials are similar. The first syzygial pair (composed of brachials 3+4) is roughly oblong, not quite twice as broad as long. The next 3 brachials are oblong, rather more than twice as broad as long, those following becoming more and more wedge-shaped and after about the twelfth triangular, broader than long, then very gradually wedge-shaped again and increasing in length, though even distally the brachials are never quite so long as broad. The arms terminate very abruptly with 3 or 4 very small brachials beyond which the terminal pinnules extend for about 3 mm.

Syzygies occur between brachials 3+4, 13+14 to 17+18 (in undivided arms usually also 9+10), and distally at intervals of 4 muscular articulations.

The pinnules resemble those of *P. flavopurpurea.*

Localities.—*Albatross* station 5167; Philippine Islands; Tawi Tawi group, Sulu (Jolo) archipelago; Observation Island bearing N. 11° W., 5.6 miles distant (lat.

4°55′10″ N., long. 119°45′30″ E.); 201 meters; coral; February 24, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 25445, 35524).

Albatross station 5166; the same general locality; Observation Island bearing N. 20° W., 4.6 miles distant (lat. 4°56′10″ N., long. 119°46′00″ E.); 177 meters; coral sand; February 24, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35525).

Remarks.—This species is known only from the three specimens collected by the *Albatross* at two closely adjacent localities in the Philippines.

PECTINOMETRA MAGNIFICA (A. H. Clark)

Plate 39, Figures 201, 202

[See also vol. 1, pt. 2, figs. 504, 505 (pinnule tip), p. 276; figs. 735, 736 (disk), p. 349.]

Calometra magnifica A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 77 (Malay Archipelago, 160 fms.; description).

Pectinometra magnifica A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 185 (synonymy; detailed description; locality), fig. 31, p. 186; Unstalked crinoids of the *Siboga*-Exped., 1918, p. 138 (in key; range; references; detailed description; station 94; also *Albatross* station 5661), p. 272 (listed).

Diagnostic features.—The ossicles of the division series bear a prominent high and narrow median keel; they are extended laterally in the form of thin lateral processes which just meet those of their neighbors; there are 41–48 cirrus segments and 20 arms 120 mm. in length.

Description.—The centrodorsal is hemispherical with the bare polar area convex, 2 mm. in diameter. The cirrus sockets are arranged in two or three closely crowded irregular marginal rows.

The cirri are XX, 41–48, 40 mm. long. The first segment is short, the next two are about twice as broad as long, and those following gradually increase in length to the fifth or seventh which is about one-third again as broad as long. The following segments are similar to almost the middle of the cirrus, at which point they begin to decrease gradually in length, in the terminal portion being twice as broad as long. At about the eighth segment the median portion of the distal dorsal edge begins to project in a small V-shaped spine. This very slowly increases distally, the whole dorsal surface of the segment becoming rounded carinate and rising at the same time until in the terminal third of the cirri the segments bear broad spatulate carinate processes which are equal in height to about one-third their width. The opposing spine is triangular, similar in shape and size to the spine on the preceding segment, blunt, the apex terminal, arising from the distal two-thirds of the penultimate segment, about equal to one-half the lateral width of the penultimate segment in height. The terminal claw is conical, equal in length to the pentulimate segment, stout, and slightly curved.

The ends of the basal rays are visible as small, though prominent, tubercles in the angles of the calyx.

The distal borders of the radials are even with the rim of the centrodorsal. Over the ends of the basal rays the radials are produced anteriorly in a narrow slightly wedge-shaped (base upward) process which terminates distally in a spatulate tip between the lateral edges of the axillaries. The IBr_1 are short, slightly trapezoidal, not in contact basally, about four times as broad as long, rather strongly convex dorsally, with a rather prominent narrow rounded median ridge. The IBr_2 (axillaries) are pentagonal, nearly or quite twice as broad as long, with the lateral edges slightly shorter than those of the IBr_1, making with them an obtuse angle, with a narrow rounded median ridge similar to that on the IBr_1 in the proximal half. The IIBr series are 2; the component elements have the rounded median ridge much less prominent than the corresponding elements of the IBr series.

The 20 arms are about 120 mm. long. The first brachials are small, wedge-shaped, twice as broad as long exteriorly, and are almost entirely united interiorly. The second brachials are considerably larger, irregularly quadrate, like the first brachials usually with a trace of a rounded median keel. The first syzygial pair (composed of brachials 3+4) is oblong, half again as broad as long. The next four brachials are oblong, twice as broad as long, with a low tubercle in the proximal half of the median line. The following two or three brachials are wedge-shaped and those succeeding are triangular, about as long as broad. The arm tips are not preserved. On the lower part of the arm traces of tubercles are found on alternate sides of the median line. The proximal third of the arm is somewhat compressed laterally and bears on either side a shallow lateral groove. The arms increase slowly in diameter up to about the twelfth brachial. From the fourth onward the brachials have moderately projecting finely spinous distal edges.

Syzygies occur between brachials 3+4, again between brachials 18+19 (rarely between brachials 17+18 or 20+21) and distally at intervals of from 4 to 9 (usually from 6 to 8) muscular articulations.

P_1 is 8 mm. long, slender and weak, with 20 segments of which the first is broad, slightly wedge-shaped, about twice as broad as the length of the proximal edge, produced distally into a high rounded carinate process. The second segment is longer, half again as broad as long, and bears a large fan-shaped carinate process with a scalloped or dentate distal edge. The third and fourth segments are considerably less in width than the second, slightly longer than broad with strong oblong carinate processes. The following segments slowly increase in length becoming twice as long as broad in the terminal portion of the pinnule and are without carinate processes. After the second segment the pinnule is rather sharply triangular in cross section, and in the distal half the distal ends of the segments project somewhat over the bases of those succeeding at the angles of the prism, this feature increasing toward the tip where the ends of the segments overlap all around and are more or less spinous. P_2 is 14 mm. long, slender but stiff, with 21 segments of which the first is broad, about twice as wide as its proximal breadth and roundedly carinate distally, the second is wedge-shaped, about as long as the proximal width, with a thin carinate process about twice as broad as high distally, the third is one-third again as long as broad, strongly carinate distally though the carination is not quite so high as that on the second segment, the fourth is twice as long as broad and carinate distally like the third, and those following are about two and one-half times as long as broad, becoming slightly longer terminally. The pinnule is strongly styliform or prismatic, the segments being more or less produced distally at the angles of the prism in the shape of a spine overlapping the base of the segment following. The distal ends of the segments are somewhat prominent and finely spinous, this feature becoming more pronounced distally. P_3 is 15 mm. long, similar to P_2 though very slightly stouter. P_4 is 14 mm. long. P_5 is 12 mm. long. P_6 is 10 mm. long, similar to P_3 but with proportionately somewhat longer segments which in the distal portion have more expanded ends. P_6 has 15 segments. P_7 is 10 mm. long, slightly stouter than P_6 with about the same number of segments which are proportionately rather shorter. P_8 is 9 mm. long, stouter than P_7, especially on the third, fourth, and fifth segments, none of which are more than twice as long as broad. The pinnules following are of the same length as P_8 and in general similar; the third-seventh segments are somewhat broadened, the pinnules tapering evenly from a maximum width on the fourth to a slender tip composed of much elongated segments which have expanded and spinous distal ends. The distal pinnules are slender, 10 mm. long.

Side- and covering-plates are highly developed.

The disk is completely covered with a pavement of rather small rounded plates, those in the interradial areas between the division series bearing conical processes in their centers. This calcareous covering is not closely united to the underlying perisome except along the ambulacra, but draws away from it on drying.

Localities.—*Investigator* station 236*a*; northeast of North Andaman Island (lat. 14°08′ N., long. 93°08′ E.); 302 meters; April 11, 1898 [A. H. Clark, 1909, 1912] (1, I. M.).

Albatross station 5661; Flores Sea; off Salayer, south of western Celebes (lat. 5°49′40″ S., long. 120°24′30″ E.); 329 meters; temperature 50.5° C.; hard bottom; December 20, 1909 [A. H. Clark, 1918] (1, U.S.N.M., 35972).

Siboga station 94; off Makassar, southwestern Celebes (lat. 5°11′12″ N., long. 119°35′24″ E.); 450 meters; bottom apparently sand and stone; June 26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From the Andaman Islands to Celebes.

Bathymetrical range.—From 302 to 450 meters; the average of 3 records is 360 meters.

Thermal range.—One record, 50.5°.

Remarks.—This species is known from three specimens, the first dredged by the *Investigator* in 1898, the second dredged by the *Siboga* in 1899, and the third dredged by the *Albatross* in 1909.

PECTINOMETRA FLAVOPURPUREA (A. H. Clark)

Plate 39, Figures 199, 200

[See also vol. 1, pt. 2, fig. 241 (brachials), p. 197; fig. 734 (disk), p. 349.]

Antedon discoidea (part) H. L. Clark, *in* McClendon, Bull. Amer. Mus. Nat. Hist., vol. 23, 1906, pp. 120, 125, 126 (Suruga Gulf and Sagami Bay; myzostomes).—Boulenger, British Antarctic ("Terra Nova") Exped., 1910, Nat. Hist. Rep., Zool., vol. 2, No. 6, Jan. 22, 1916, p. 136 (host of *Myzostomum cysticolum*).

Antedon flavopurpurea A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 131 (color), p. 134 (description; *Albatross* station 4935).

Calometra flavopurpurea A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 313 (localities in Sagami Bay); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, pp. 222, 223 (compared with *C. carduum*).

Pectinometra flavopurpurea A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 188 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 138 (in key; range).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 5 (364–728 meters), p. 5 (Sagami Bay), p. 97 (Bock's stations 34, 35, 36; detailed notes), p. 181 (listed), figs. 72, 73, p. 88; Zool. Bidrag Uppsala, vol. 9, 1924, p. 11 (pinnule replacing arm), pp. 41, 42 (obliquity of brachials), p. 44 (arms and pinnules), p. 46 (interior obliqueness of brachials), p. 51 (joint faces), p. 53 (axillaries), p. 54 (abuormal pinnulation), p. 79 (nonmuscular articulations), fig. 13, p. 45 (ventral view of brachials with the muscles removed), fig. 18, p. 48 (lateral view of brachials), figs. 36, 37, p. 52 (articular surfaces of brachials), fig. 40, p. 58 (abnormal pinnulation), figs. 76, 105, 166, 167, 300 (articulations); Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 2 (occurrence of IIBr series; station 26; 360 meters), p. 32 (station 26; notes), p. 69 (listed); Kungl. Fysiogr. Sällsk. Handl., New ser., vol. 45, No. 11, 1934, p. 20.

Peetiometra flavopurpurea Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 54 (pinnules and brachial obliqueness), figs. 36, 37, p. 52; figs. 166, 167, p. 98 (pinnule articulation).

Diagnostic features.—The ossicles of the division series bear a prominent median keel which on the IBr series is lower and more uniform in height than in *P. magnifica;* there are 30 cirrus segments and 20 arms about 70 mm. in length.

Description.—The centrodorsal is low hemispherical with the dorsal pole flat or slightly convex. The marginal cirrus sockets are arranged in 2 closely crowded alternating rows; there are roughly 3 sockets immediately beneath each radial.

The cirri are XV–XX, 25–30, 15 mm. long. The first 4 segments are about twice as broad as long, the first the shortest and those following gradually increasing in length; the fifth is about as long as broad and those succeeding are of the same length or slightly longer than broad, after the tenth gradually becoming shorter. From the tenth onward the segments are provided with broad and prominent, though blunt, dorsal spines. The opposing spine is low and triangular. The terminal claw is stout, not so long as the penultimate segment, and relatively slightly curved.

The ends of the basal rays are visible as small tubercles in the interradial angles.

The radials are usually concealed by the centrodorsal but are sometimes more or less visible in the interradial angles. The IBr_1 are short, about four times as broad as long, roundedly carinate, laterally in apposition with their neighbors on either side. The IBr_2 (axillaries) are broadly triangular, twice as broad as long, with the lateral angles produced into more or less of a blunt spine or tubercle. The IIBr series are 2. The $IIBr_1$ have a broad flangelike production of the outer edge which just meets that of the $IIBr_1$ on the adjacent ray and in width is usually equal to about one-third of the width of these ossicles. The $IIBr_2$ resemble the IBr_2; the distal angle is more or less produced.

The arms are 20 in number, occasionally a few less, about 70 mm. in length. The first brachials are slightly wedge-shaped, exteriorly produced laterally into a thin keel, more especially in the proximal half; this keel is not so large as the lateral processes on the $IIBr_1$. The second brachials are wedge-shaped, convex exteriorly, and of about the same size as the first. The first syzygial pair (composed of brachials 3+4) is about as long as broad, with the distal edge somewhat everted and finely spinous. The next 2 brachials are oblong, about twice as broad as long, those following quickly becoming triangular and about as long as broad. The terminal brachials fall about 4 mm. short of the tips of the distal pinnules. All of the brachials overlap somewhat, and have very finely spinous distal ends. The longer sides of l the brachials are convex.

Syzygies occur between brachials 3+4, again about 13+14 or 15+16, and distally at intervals of 4 or 5 muscular articulations.

P_1 is small, slender, flexible, and delicate, 4 mm. long with 15 segments of which the first is much enlarged, as broad as the length of the second brachial and about half as long, the second is smaller, about half again as broad as long, and the remainder are very small, slightly longer than broad. P_2 is 6 mm. or 7 mm. long, moderately stout, stiff, and spinelike, with 15–18 segments, the first large, about twice as broad as long, and oblong, the second smaller, about as long as broad, and the remainder about half again as long as broad, becoming very slightly longer toward the tip where their distal ends are somewhat prominent. P_3 is from 7 mm. to 12 mm. long, most commonly not greatly longer than P_2, rarely elongated, similar to P_2 but slightly stouter with the articulations slightly swollen. P_4 and P_5 are similar but of decreasing length, P_5 being 6 mm. long. The following pinnules are of about the same length, but they have the third, fourth, and fifth segments somewhat expanded and the remainder elongate with projecting distal ends. The expanded portion of the pinnule gradually comes to occupy more and more of its length, the slender tip becoming gradually shorter and shorter, while at the same time the pinnule gradually increases in length. The distal pinnules are 9 mm. long with 18 segments of which the first is oblong, about twice as broad as long, the second is trapezoidal, somewhat longer than the first, and the following are about twice as long as broad except for the terminal 5 or 6 which are very slender and elongate with overlapping and spinous distal ends. The first three pinnules are rounded prismatic. The distal pinnules are very sharply prismatic and are rather stout and closely set, giving the arm much the same appearance characteristic of the species of Thalassometridae or Charitometridae in contrast to the conditions seen in *Calometra* or in *Neometra*.

Notes.—A specimen from Dr. Sixten Bock's station 36 as described by Gislén has the centrodorsal 2.2 mm. in diameter with the bare dorsal pole 1.5 mm. in diameter. The cirrus sockets are arranged in 2 rows and 10 columns. The cirri are XIX, the peripheral with 25–27, the dorsal with 21–24 segments. The fourth segment is a little longer than broad, the fifth and sixth are the longest, one quarter again as long as broad, and the distal are twice as broad as long. From the seventh segment onward dorsal processes are developed which at first take the form of a high thin keel, later shortening into a spine. The opposing spine is similar to the spines on the segments immediately preceding, and reaches one-third the width of the penultimate segment in height. The terminal claw is shorter than the penultimate segment. The radials are produced into interradial projections which separate the IBr_1; these last have a median slightly bifid crest and small lateral processes which meet above the processes from the radials; they are three times as broad as long. The IBr_2 (axillaries) are twice as broad as long and in the proximal half show a median crest which continues the one on the IBr_1. The IIBr series are 2. The 18 arms are 50 mm. long. The brachials do not overlap, and distally become somewhat longer than broad. The arrangement of the syzygies on the 3 arms on one ray is as follows: In the outer arm arising from the IIBr series, between brachials 3+4, 13+14, 19+20, 25+26; in the inner arm arising from the IIBr series, between brachials 3+4, 12+13, 18+19, 26+27; in the arm arising directly from the IBr axillary, between brachials 3+4, 11+12, 17+18, 22+23, 27+28, 32+33.

P_1 is about 4 mm long, much more slender than those following, with 13 segments of which the first 2 bear carinate processes; the first segment is 3 times as broad as long, the second is two and one-half times as broad as long, and the third is about as long as broad; the distal segments are slender and longer than broad. P_2 is 4.2 mm. long with 10 segments. P_3 is 3.7 mm. long with 9 segments. P_4 is 3.8 mm. long with 9 segments, the carinate processes on the first 2 being insignificant. The distal pinnules are 6.5 mm. long with 15–16 segments of which the first and second are short and somewhat expanded, those following are smooth, three or four times as long as broad, and the last three are slender with spiny distal ends.

A specimen from station 35 has the centrodorsal 3 mm. in diameter with the bare dorsal pole 2.5 mm. in diameter. The cirri are XX, 25–30, from 14 mm. to 18 mm. long, arranged in 5 interradial groups which are separated by radial interspaces. The radials are not very much produced interradially. The 17 arms are 65 mm. long, and are composed of about 100 brachials, which are slightly overlapping with serrate ends. The intersyzygial interval is from 4 to 6, sometimes as much as 11, muscular articulations. P_1 is from 4 mm. to 5.2 mm. long with 14–15 segments, of which the third is half again as long as broad. P_2 is from 6.8 mm. to 7 mm. long with 14 segments of which the fourth-tenth are from two to two and one-half times as long as broad. P_3 is 6.5 mm. long with 13 segments, stouter than the 2 preceding. P_4 is 4.7 mm. long with 9+ segments. The first 2 segments bear carinate processes as far as P_7. The distal pinnules are from 7.5 mm. to 8 mm. long with 15–17 segments. The disk is 5 mm. in diameter, and is covered with closely packed granules.

In a specimen from station 34 the centrodorsal is 2.3 m. in diameter, with the bare dorsal pole 1.8 mm. in diameter. The cirri are XX, 22–31, from 9 mm. to 17 mm. in length, indistinctly separated into groups. The radials have small interradial processes. The 18 (? or 19) arms are 75 mm. in length. P_1 is 5.5 mm. long with 18 segments. P_2 is 8 mm. long with 19 segments. P_3 is 8.5 mm. long with 17 segments. P_4 is 8 mm. long with 15 segments. The distal pinnules are from 9 mm. to 9.5 mm. long with 15–16 segments.

A second specimen from station 34 has the centrodorsal 3.2 mm. broad with the bare dorsal pole 2.5 mm. across. The cirri are XXIII, 29–33, from 14 mm. to 18 mm. long. The arms, about 20 in number, are 85 mm. long. The radials are not very much produced interradially. The IBr_1 are in contact basally. The intersyzygial interval is from 11 to 14, rarely as few as 6, muscular articulations. P_1 is composed of 19 segments. P_2 is 9.5 mm. long with 21 segments. P_{10} is 6.2 mm. long with 13 segments. The distal pinnules are from 9 mm. to 9.5 mm. long with 15 segments.

In a third specimen from station 34 the centrodorsal is 4 mm. across with the bare dorsal pole 3 mm. in diameter. The cirri are XXII, 27–37, from 17 mm. to 24 mm. long. The cirrus groups are well separated interradially. The IBr axillary is twice as broad as long, and almost without a median tubercle. There are about 20 arms. P_1 is 7 mm. long with 22 segments. The disk is coarsely granulated and strongly incised, with the greatest diameter 8 mm. and the least 4 mm.

In a fourth specimen from station 34 the cirri are XXII, 25–31, from 14 mm. to 20 mm. in length. The arms are about 20 in number, 90 mm. long, with about 130 brachials of which the last 30 or so show a slight median carination. The intersyzygial interval is from 4 to 10 muscular articulations. P_1 is 5.5 mm. long with 18 segments. P_2 is 9.5 mm. long with 17 segments. P_3 is from 8.5 mm. to 9 mm. long with 16–17 segments. P_4 is 9.5 mm. long with 16 segments. P_9 is 6 mm. long with 13 segments. The distal pinnules are from 9 mm. to 10 mm. long with 17 segments. The disk is regenerating, and is from 3.5 mm. to 7 mm. in diameter.

A fifth specimen from station 34 has the bare dorsal pole of the centrodorsal 2 mm. in diameter. The cirri are XIX, 25–35, from 14 mm. to 18 mm. long. There are about 16 arms 45 mm. in length. P_1 is 4.5 mm. long with 15 segments. P_2 is 7 mm. long with 17 segments. The distal pinnules are 8.5 mm. long with 14 segments. P_a is small, from 3.5 mm. to 4 mm. long. P_b and P_c are about 9 mm. long, and are composed of 17 segments. The disk is in process of regeneration.

Gislén has noticed that the interradial processes of the radials are most marked in the youngest individuals, the IBr_1 then increasing rapidly in size and soon coming into contact with each other laterally. In the largest individuals the IBr axillary is almost rhombic, and shows a variable development of carination. He remarks that in the fourth specimen from station 34 the carinate processes on the first two segments of the proximal pinnules are distinct out to about the tenth pinnule, and still noticeable on the distal pinnules.

Remarks.—Though this species has been dredged 12 times off southern Japan in 115 to 365 meters, and *Neometra multicolor* has been found 31 times in the same region between 20 and 600 meters, the two species have been dredged together only once, by Alan Owston at a depth of 201 meters.

Although the bathymetric range of this species falls wholly within that of *Neometra multicolor*, so far as is at present known, the average of the records is 202 meters as against 114 for the latter.

Calometra callista has never been found with this species, though it inhabits the same region and its average depth of habitat is 181 meters, as compared with 202 meters for this form; but at three of the seven stations from which *Calometra callista* has been reported (*Albatross* stations 4836 and 4894 and the *Golden Hind* station) it was found associated with *Neometra multicolor*.

Localities.—*Albatross* station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 58° E., 4.5 miles distant (lat. 30°57′20″ N., long. 130°35′10″ E.); 188 meters; temperature 15.89° C.; stones; August 16, 1906 [A. H. Clark, 1907] (2, U.S.N.M., 22623, 35513).

Albatross station 3717; Sagami Bay, Japan; Ose Zaki bearing S. 34° E., 0.8 mile distant; 115–183 meters; volcanic sand, shell and rock; May 11, 1900 [McClendon, 1906] (3, U.S.N.M., 35511; M. C. Z., 263).

Sagami Bay (lat. 35°03′ N., long. 138°47′ E.); 155 meters; Alan Owston, August 14, 1902 [A. H. Clark, 1908] (1, U.S.N.M., 35520).

Sagami Bay (lat. 35°03′ N., long. 138°47′ E.); 201 meters; Alan Owston, August 28, 1902 [A. H. Clark, 1908] (1, U.S.N.M., 35521).

Sagami Bay (lat. 35°04′ N., long. 138°47′ E.); 201 meters; Alan Owston, August 6, 1902 [A. H. Clark, 1908] (5, U.S.N.M., 35519).

Dr. Sixten Bock's Expedition to Japan station 34; Sagami Bay, off Okinose; 731 meters; June 26, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan station 35; Sagami Bay, off Okinose; 731 meters; June 28, 1914 [Gislén, 1922].

Dr. Sixten Bock's Expedition to Japan station 36; Sagami Bay, off Misaki; 366 meters [Gislén, 1922].

Albatross station 5068; Suruga Gulf; Ose Saki bearing S. 18° E., 0.9 mile distant (lat. 35°02′25″ N., long. 138°46′55″ E.); 141–239 meters; temperature 17.22° C.; black sand and broken shells; October 15, 1906 (5, U.S.N.M., 35518).

Albatross station 5069; Suruga Gulf; Ose Saki bearing S. 6°30′ E., 1.7 miles distant (lat. 35°03′10″ N., long. 138°47′00″ E.); 197–239 meters; temperature 13.22° C.; mud, sand, and broken shells; October 15, 1906 (1, U.S.N.M., 35515).

Albatross station 5070; Suruga Gulf; Ose Saki bearing S. 8° W., 1.8 miles distant (lat. 35°03′25″ N., long. 138°47′40″ E.); 197 meters; temperature 14.22° C.; mud, sand, and broken shells; October 15, 1906 (1, U.S.N.M., 35517).

Suruga Gulf; *Albatross* (1, U.S.N.M., 35514).

Albatross station 5090; Uraga Straits, at the entrance to Tokyo Gulf; Joga Shima light bearing N. 6° W., 4.4 miles distant (lat. 35°03′50″ N., long. 139°37′30″ E.); 365 meters; temperature 8.67° C.; pebbles and broken shells; October 26, 1906 (3, U.S.N.M., 35512, 35516; M. C. Z., 342).

Geographical range.—Southern Japan from the Eastern Sea to Tokyo Gulf.

Bathymetrical range.—From 155 (?115) to 365 meters; the average of 9 records is 202 meters.

Doctor Bock's depths are not considered in the preceding statement as they represent the length of wire out, not the actual depths at which the animals were living.

Thermal range.—From 8.67° C. to 17.22° C.; the average of five records is 13.84° C.

History.—This species was first mentioned under the name *Antedon discoidea* by Prof. Jesse Francis McClendon in a paper on myzostomes published in 1906. The name was given Professor McClendon by Dr. Hubert Lyman Clark, who at the time was engaged in working on the crinoids collected in the waters of southern Japan by the *Albatross* in 1900 and 1902. Later Dr. Clark was so very kind as to turn all these Japanese crinoids, together with his notes on them, over to me so that I might have them as a supplement to the much larger collection that I made in the same area in 1906.

In 1907 I described this species under the name of *Antedon flavopurpurea* from a specimen from *Albatross* station 4935, transferring the species to the new genus *Calometra* later in the same year. In 1908 I recorded eight specimens from three localities in Sagami Bay that had been dredged by Alan Owston in his yacht the *Golden Hind.* Mr. Owston had showed me these specimens when I visited his store in Yokohama in 1906, and they were subsequently purchased by Frank Springer and deposited in the U. S. National Museum. In another paper published in 1908 I compared this species with a new species, *Calometra* (*Pectinometra*) *carduum.* In my memoir on the crinoids of the Indian Ocean published in 1912 I transferred *flavopurpurea* to the new genus *Pectinometra* and gave the synonymy and range, and in 1915 I discussed the range of *Pectinometra flavopurpurea* and its significance. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 I inserted *flavopurpurea* in a key to the species of the genus *Pectinometra* and gave the range.

Prof. Torsten Gislén in 1922 recorded and gave detailed notes on a number of specimens from Prof. Sixten Bock's stations 34, 35, and 36. In 1924 he discussed the structure of this species in great detail. In 1927 he recorded and gave notes on additional specimens from Dr. Th. Mortensen's station 26, and in 1934 he described the type of arm division and its significance.

Genus CALOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 134, and following authors.

Calometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 362 (diagnosis; genotype *Antedon callista* A. H. Clark, 1907); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (same); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (pinnules sharply triangular, not cylindrical), p. 135 (referred to Tropiometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to Tropiometridae), p. 212 (occurs in Japan); Amer. Nat., vol. 42, No. 500, 1908, p. 541 (only known from Indo-Pacific-Japanese area); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (same); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (extraordinary development of side and covering plates); Vid. Medd. Naturh. Foren. København, 1909, p. 182 (character of the articular faces of the radials), p. 193 (probably occurs at Singapore, though not yet discovered there); Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 129 (characteristic of the Japanese fauna; significance); Mem. Australian Mus., vol. 4, 1911, p. 728 (species of this genus distributed among 4 genera [not named] which collectively form the new family Calometridae); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 82 (P_1 compared with that of *Strotometra priamus*); Crinoids of the Indian Ocean, 1912, p. 17 (only known from southern Japan), p. 23 (confined to southern Japan; depth), p. 42 (removed from the Tropiometridae, created a special family, and its species distributed among 4 genera), p. 58 (in key), p. 177 (original reference; type).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 9 (relationship to *Neometra*), pp. 95, 96; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.

Gephyrometra (part) A. H. Clark, Crinoids of the Indian Ocean, 1912, pp. 10, 23, 33.

Diagnosis.—A genus of Calometridae in which the arms are 10–15 in number, the IIBr series being 2; the radials are not extended upward interradially, or if they are the extensions are narrow and the bases of the IBr_1 meet over them; the division series may be separated, or more or less in contact through lateral extensions of the ossicles; and P_2 and the following pinnules are short, subequal in length.

Geographical range.—From the Kei Islands to the Moluccas and northward to southern Japan as far east as Sagami Bay.

Bathymetrical range.—From 100 to 439 meters.

Thermal range.—From 11.61° C. to 15.89° C.

History.—The first known species of this genus was described as an *Antedon* by Dr. P. H. Carpenter in 1888. Carpenter placed it in his *Acoela* group together with *Antedon* (*Poecilometra*) *acoela*, belonging to the family Charitometridae, though he said that the two differ "in nearly all the characters of the cirri, arms, and pinnules."

In 1907 I established the genus *Calometra* with *Antedon callista* A. H. Clark, 1907, as the genotype. This genus was given its present significance in my memoir on the crinoids of the Indian Ocean published in 1912 by the creation of the new genera *Pectinometra*, *Neometra*, and *Gephyrometra* to include species previously assigned to *Calometra*.

KEY TO THE SPECIES OF THE GENUS CALOMETRA

a^1. Larger, the arms 90–100 mm. long; usually 42–50 cirrus segments; ossicles of the division series with everted edges and brachials with everted distal ends giving the animal a very rough appearance (Kei Islands to the Moluccas; 239–439 meters) .... **discoidea** (p. 386)

a^2. Smaller, the arms 55–70 mm. long; not over 40 cirrus segments; edges of the ossicles of the division series and ends of the brachials little if at all everted so that the animal appears smooth (southern Japan; 100–195 [?254] meters) .... **callista** (p. 390)

CALOMETRA DISCOIDEA (P. H. Carpenter)

[See vol. 1, pt. 2, fig. 311 (proximal pinnules), p. 223.]

Antedon discoidea P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 134 (description; *Challenger* station 192), pl. 10, figs. 1, 2.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888=*Gephyrometra discoidea*).

Calometra discoidea A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 545 (*Albatross* station 5577); Zool. Anz. vol. 39, 1912, No. 11/12, p. 422 (cirri compared with those of *C. diana*); Crinoids of the Indian Ocean, 1912, p. 179 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 42 (published references to specimens in the B. M.; *Challenger* station 192; characters).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 90 (synarthrial tubercles).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 646 (Rotti Strait; 100 fathoms).

Gephyrometra discoidea A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (editorial error).

Diagnostic features.—This species is larger than *C. callista*, the arms being from 90 mm. to 100 mm. in length; the ossicles of the division series have everted edges and the brachials have everted distal ends so that the animal has a very rough appearance; there are usually 42–50 cirrus segments.

Description of the larger specimen from Albatross *station 5617* (*No. 35475*).—The centrodorsal is discoidal with a broad smooth slightly concave dorsal pole 3 mm. in diameter. The cirrus sockets are arranged in 2 crowded more or less regularly alternating marginal rows.

The cirri are XXII, 38–47 (usually 42–45), from 25 mm. to 30 mm. long. The first 4 segments are short, about twice as broad as long, the fifth is about one third broader than long, and the sixth-tenth are from slightly longer than to half again as long as the proximal width with the ventral and dorsal profiles forming a slight angle with each other and both almost imperceptibly concave so that both the dorsal and ventral ends of the segments are slightly projecting. After the tenth the length of the segments rather rapidly decreases so that the segments in the distal third of the cirri are very short, about twice as broad as long. In these short distal segments the cirri taper very slightly to the tip. On about the twelfth a slight longitudinally elongate tubercle with a sharply rounded crest appears at the distal end of the segments on the dorsal side which in the short distal segments develops into a high broad dorsal spine the base of which involves the whole dorsal surface of the segment in the median line while the proximal border is strongly convex and the distal straight or slightly concave and about at right angles to the longitudinal axis of the cirri. The crests and the points of these spines are slightly blunted. The opposing spine arises from the entire dorsal surface of the penultimate segment which, as a result of the distal taper of the cirri, is very small. It is triangular with the distal border forming a straight line with the distal edge of the penultimate segment and the proximal border strongly inclined. The terminal claw, if uninjured, is slightly longer than the penultimate segment, rather slender and moderately curved.

The radials are visible as narrow bands beyond the concave radial regions of the centrodorsal. Interradially they are extended upward by a narrowly spatulate process, which extends as far as the lateral angles of the IBr axillaries which meet above it. Basally it is almost or quite concealed by the very close approximation of the proximal angles of the IBr_1.

The IBr_1 are very short, from 4 to 6 times as broad as long, with slightly converging sides. The lateral angles are very nearly or quite in apposition. The distal border is nearly straight, but curves slightly upward laterally to the somewhat produced and sharply rounded anterolateral angles. The IBr_2 (axillaries) are low, short, twice as broad as long or even broader. Ventrally they are strongly produced laterally into a triangular process, the apices of the triangles of adjacent IBr_2 just meeting over the anterior production of the radials; the distal border of the triangular processes runs from the lateral apex diagonally upward to near the distal end of the outer side of the first brachial so that the first brachials are both proximally and exteriorly bounded by the axillaries. The distal borders of the axillaries are prominently everted, but not spinous.

The 12 arms are 95 mm. in length. The IIBr series are 2. The first brachials are small and short, somewhat more than twice as broad as the median length; the outer border is almost parallel with the axis of the IBr series and is slightly concave, the deepest part of the concavity being near the distal end. The inner borders of adjacent first brachials are in apposition in the proximal two-thirds, the distal thirds diverging in almost a straight line. The proximal edge, and the distal edge except in the middle, are more or less everted, but not spinous. The second brachials except at the base are produced outward on the outer side so as to form an attachment for the enormously enlarged first segment of P_1. The lateral edge of this production runs from a point far beyond the anterolateral angle of the first brachial upward and slightly inward to the somewhat produced anterolateral angle of the second brachial. The inner border of the second brachials is very short and concave. The distal border is approximately parallel with the rim of the centrodorsal, and consequently very oblique; it is somewhat everted. The first syzygial pair (composed of brachials 3+4) is wedge-shaped, twice as long interiorly as exteriorly and twice as broad as the median length. The sides of the two components, the hypozygal and the epizygal. form approximately right angles with each other on either side. The distal border is rather strongly everted. The following brachials are wedge-shaped, almost triangular, twice as broad as the median length, after about the thirteenth becoming triangular, about as long as broad, and after about the end of the proximal third of the arm wedge-shaped again and slightly shorter. The terminal brachials are about as long as broad and obliquely wedge-shaped. On about the tenth brachial the middorsal region becomes broadly swollen; this soon narrows into a broadly rounded eminence lying on succeeding brachials on either side of the median line, and in the outer half of the arm it becomes a very blunt and inconspicuous median carination. All the brachials have everted but smooth ends, giving the arms a very rough appearance.

P_1 is 6 mm. long and is composed of 20 segments. The first segment is enormously enlarged, extending from the proximal end of the pinnule socket on the second brachial to a broadly rounded distal border which reaches the distal border of the fourth (epizygal) brachial, the eversion of this border being somewhat arched above it. The lower border of this segment is convex; the upper, which bears the second segment, is very deeply concave and only about two-thirds as long as the lower. The second segment is much smaller than the first, but more than twice as broad as the third. The lower border, by which it is attached to the first, is straight; the distal border is straight and parallel with the lower in the proximal two-thirds, but in the distal third is expanded into a broad lobe which distally encircles the third segment and reaches to the fourth. The third and following segments are very small, the third being rather less than one-third as broad as the second. They taper very gradually to the pinnule tip, and after the seventh become very slightly longer than broad.

P_2 is nearly 8 mm. long, longer and considerably stouter than P_1 but of the same general type, composed of 18 segments. The first segment is not so much enlarged as the first segment of P_1. The second is about the same size as the second segment of P_1. The third segment is about two-thirds as broad as the third segment of P_1. The third and following segments gradually taper to the tip. The third segment is rather more than half again as long as broad, the fifth is about as long as broad, and the remainder are from half again to twice as long as broad. P_3 differs from the preceding pinnules in being stiffened, spinelike and prismatic with the first two segments much less enlarged. It is 9 mm. long with 15 segments of which the third is about two-thirds as broad as the second and the following gradually and regularly taper to a sharp point. The third is about as long as broad, and the fifth and following are about twice as long as broad with increasingly prominent and finely spinous distal ends. The third and following segments have a prominent narrowly rounded carination. The distal pinnules are 10 mm. long with 20 segments of which the third and following are about three times as long as broad, except the terminal 5 or 6, beyond the distal end of the ambulacral groove, which are smaller and much shorter.

Carpenter's description of the type specimen.—The centrodorsal is a thick disk with the dorsal surface free; there are from 15 to 18 cirrus sockets in a single or partially double marginal row.

The cirri are XV–XVIII, 40–50, up to 27 mm. in length. A few of the earlier segments are longer than broad and the following gradually develop a sharp dorsal keel.

The radials are short, except at the angles of the calyx where the ends of the basal rays sometimes appear.

The IBr_1 are short, broad and oblong, and the IBr_2 (axillaries) are barely pentagonal. Both ossicles have large muscle plates, and their dorsal surfaces rise toward the middle of their apposed edges. The IBr series are well separated.

The 10 arms are about 80 mm. in length. The first brachials are almost oblong. The second are bluntly triangular with a large lateral process bearing the pinnule socket. The next few brachials each have a process of the same kind, but gradually decreasing in size. After the tenth the brachials become triangular, as long as broad and slightly overlapping, and more quadrate distally.

Syzygies occur between brachials 3+4, again between brachials 11+12 to 15+16, and distally at intervals of from 3 to 6, usually 4, muscular articulations.

The first 2 pairs of pinnules have 20 or more short segments the first of which is much expanded dorsally and the next 2 slightly so. This expansion gradually dies away in the following pinnules, which increase in size, becoming stiff and rod like, and are composed of long cylindrical segments after the first 2, which are laterally compressed. Several of the distal pinnule segments are without the ambulacral skeleton.

The covering plates of the pinnule ambulacra according to Carpenter are supported on a well-developed limestone band which is not clearly divided into side plates. The sacculi concealed by it are very large and closely set.

The disk and the brachial ambulacra are very much plated; the disk is 6 mm. in diameter.

Although in the description Carpenter refers to the segments of the pinnules beyond the oral as cylindrical, he later says that they are somewhat carinate. In the figure which he gives of the pinnule on the eighth brachial the segments are shown as sharply prismatic.

Notes.—The second specimen from *Albatross* station 5617 has 10 arms 90 mm. long; the cirri are 25 mm. long with 40–43 segments.

The specimen from *Albatross* station 5577 has 10 arms about 100 mm. long; the cirri are XIX, 44–48, from 25 mm. to 30 mm. long.

Of the four specimens in the British Museum from *Challenger* station 192 two are large and two are small. In the largest the cirri are 38 mm. long, with the longest segments about one-third again as long as broad or slightly longer. The IBr_1 are extended laterally to an anterior process from the radials so that there is a very prominent gap between the axillaries.

The specimen from the Danish Expendition to the Kei Islands station 54 is small, with the arms about 40 mm. long.

Localities.—Rotti Strait, between Rotti and southwestern Timor; 183 meters; cable repair ship *The Cable*, Eastern and Associated Telegraph Co.; from the Banjuwangi-Darwin No. 2 cable [A. H. Clark, 1929] (1, B. M.).

Challenger station 192; near the Kei Islands (lat. 5°49′14″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (4, B. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 54; 85 meters; sand and coral; May 9, 1922 (1, C. M.).

Albatross station 5617; Moluccas; Gilolo Island; Ternate Island, Dodinga Bay (S. E.), bearing S. 45° W., 7 miles distant (lat. 0°49′40″ N., long. 127°25′30″ E.); 239 meters; November 27, 1909 (2, U. S. N. M., 35475, 36046).

Albatross station 5577; Philippine Islands, north of Tawi Tawi; Mt. Dromedario bearings S. 9° W., 10.9 miles distant (lat. 5°20′30″ N., long. 119°58′51″ E.); 439 meters; bottom temperature 54.3° C.; coarse sand; September 23, 1909 (1, U.S.N.M., 35474).

Geographical range.—From southwestern Timor and the Kei Islands to the Moluccas and the southern Philippines.

Bathymetrical range.—From 85 to 439 meters; the average of the 5 records is 240 meters.

Thermal range.—One record, 54.3° C.

History.—This species was first described as *Antedon discoidea* by Dr. P. H.

Carpenter in 1888 from four specimens dredged by the *Challenger* at station 192. It was transferred to the new genus *Calometra* upon its establishment in 1907. In 1911 I recorded and gave notes upon a specimen of *Calometra discoidea* from *Albatross* station 5577, and in 1912 I compared its cirri with those of a new species, *Calometra* (*Neometra*) *diana*. In my memoir on the crinoids of the Indian Ocean published later in 1912 I gave the synonymy and range of *Calometra discoidea*, and in a paper on the crinoids of the British Museum published in 1913 I gave some notes on Carpenter's type material.

Prof. Torsten Gislén in 1924 discussed the synarthrial tubercles of this species, and in 1929 I recorded a broken specimen that had been found on a cable brought up from a depth of 100 fathoms in Rotti Strait by the cable repair ship *The Cable* and presented to the British Museum by the Eastern and Associated Telegraph Co.

CALOMETRA CALLISTA (A. H. Clark)

Plate 36, Figure 193

[See also vol. 1, pt. 1, figs. 357, 358 (cirri), p. 293; pt. 2, fig. 201 (lateral view), p. 133; figs. 320 (proximal pinnules), 334 (middle pinnules), p. 227; fig. 737 (disk), p. 349.]

Antedon callista A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 132 (color); p. 135 (description; *Albatross* station 4903).

Antedon separata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 133 (description; *Albatross* station 4893).

Calometra callista A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan); Crinoids of the Indian Ocean, 1912, p. 179 (synonymy; range); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (range and its significance).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 96 (characters of the lower pinnules).

Calometra separata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 363 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 313 (Sagami Bay); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (range and its significance).

Pectinometra separata A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 188 (synonymy; range).

Diagnostic features.—This species is smaller than *C. discoidea*, the arms being from 55 mm. to 70 mm. in length; the edges of the ossicles of the division series and the distal ends of the brachials are little if at all everted so that the animal appears smooth; there are not over 40 cirrus segments.

Description.—The centrodorsal is very thick discoidal with slightly converging sides and a broad slightly concave polar area. The cirrus sockets are arranged in two and a partial third closely crowded and irregular rows.

The cirri are about XXX, 40, 23 mm. long. The first segment is short, the second is longer, the third is about as long as broad, the fourth is about half again as long as broad, and the fifth is about twice as long as broad. The segments immediately following are similar to the fifth. After the twentieth the segments become shorter, so that the twenty-fifth and following are about as long as broad. After the fourth or fifth the dorsal portion of the distal edge begins to project slightly, this gradually becoming more prominent so that the distal portion of the cirri is strongly serrate in lateral view. The opposing spine is terminally situated, triangular, arising from the entire dorsal surface of the segment, and reaching about half its width in height. The terminal claw is about as long as the penultimate segment, rather stout and moderately curved.

The ends of the basal rays are visible as small tubercles in the angles of the calyx.

The radials are short, about twice as long in the interradial angles as in the median line, evenly curved anteriorly. The IBr_1 are short, oblong, about four times as broad as long. The IBr_2 (axillaries) are triangular, rather less than twice as broad as long. The IBr_1, $IIBr_1$ and first brachials have somewhat produced and flangelike lateral edges by which they are in apposition laterally. The lateral borders of the aixillaries are angular or very short, and sometimes are more or less produced, the production equaling the width of the lateral projection of the immediately preceding ossicles. The IIBr series are 2, resembling the IBr series and, like them, rising to a rounded tubercle on the line of the articulation between them.

The 15 arms are 70 mm. long. The first brachials are short, slightly longer outwardly than inwardly where they are united for almost or quite their entire length. The second brachials are about twice as long, irregularly quadrate. The first syzygial pair (composed of brachials 3+4) is not quite so long as broad, and is slightly constricted centrally. The next 2 brachials are slightly wedge-shaped, about twice as broad as long, and the following are triangular, about as long as broad with the longer side convex and the distal edges slightly overlapping. Distally the brachials become very obliquely wedge-shaped; the terminal 4 or 5 are very small, and fall about 5 mm. short of the ends of the distal pinnules.

Syzygies occur usually, but not always, between brachials 3+4, 9+10 to 13+14, and distally at intervals of 3 or 4 muscular articulations.

P_1 is 5 mm. long, very slender, flexible and delicate, composed of 20 segments of which the first is greatly expanded, about as broad as the entire lateral edge of the second brachial, the second is similar but smaller, and the remainder very small and about as long as broad with the distal ends prominent. P_2 is 7 mm. long, much stouter than P_1 and stiff, with 20 segments of which the first is short, but as broad as the outer side of the segment, the second is longer but not so broad, the third is about half again as broad as long, the fourth is about half again as long as broad, and the remainder become progressively elongated, with the distal ends increasingly prominent. The following pinnules are similar, gradually decreasing in length to about P_8, which is 5 mm. long, then increasing again and reaching 8 mm. distally. The enlargement of the first two segments is marked on the first 3 pinnules, then decreasing markedly and remaining practically uniform to the end of the arm. In the distal pinnules the first segment is crescentic, about half again as broad as the third, the second is trapezoidal, about twice as broad as long, and the remainder are about twice as long as broad. The pinnules in section are triangular with the corners rounded, especially on P_1 and P_2.

Description of the form formerly designated as separata.—The centrodorsal is discoidal, rather thick, with the broad bare polar area slightly convex; there is a single crowded row of about 15 cirrus sockets.

The cirri are XV, 30–35, 15 mm. long, resembling those of *Neometra multicolor*. But while generally the longest proximal cirrus segments are not more than half again as long as broad, exceptionally slender cirri sometimes occur in which the longest segments are more than twice as long as broad. There is one of these exceptionally slender cirri in the type specimen of *separata*, and the only remaining cirrus in the type specimen of *callista* is of this character.

The ends of the basal rays are usually, but not always, visible as small tubercles in the interradial angles.

The distal edge of the radials is even with the rim of the centrodorsal and is nearly straight so that the radials are not prominent interradially. The IBr_1 are oblong, 3 or 4 times as broad as long, with produced lateral borders which are in apposition with the similarly produced lateral borders of the neighboring IBr_1. The IBr_2 (axillaries) are low pentagonal, over twice as broad as long, produced laterally into a thin edge which curves forward and encloses the outer side of the first brachial in the form of a broad hooklike process which may reach as far as the second brachial, or only halfway up the side of the first brachial; sometimes it is only slightly developed.

Arms 10–12 (usually 10, in 2 individuals 11 and in 1, 12), from 55 mm. to 60 mm. long, resembling those of *C. callista.*

P_2, which is from half again to twice as long as P_1, is 8 mm. long; from this point the pinnules very gradually decrease in length, then gradually increase to 9 mm. distally.

Notes.—Of the 14 specimens examined 10 had 10 arms, 2 (from stations 4894 and 4936) had 11 arms, 1 (from station 4936) had 12 arms, and 1 (from station 4903) had 15 arms.

Localities.—Eighty miles west of Nagasaki (lat. 32°15′ N., long. 128°20′ E.); 274 meters; bottom temperature 12.8° C.; Captain Suensson, May 15, 1904 (1, C. M.).

Albatross station 4895; Eastern Sea, southwest of the Goto Islands; Ose Saki light bearing N. 42° E., 4.7 miles distant (lat. 32°33′10″ N., long, 128°32′10″ E.); 174 meters; temperature 13.28° C.; green sand, broken shells, and pebbles; August 9, 1906 (2, U.S.N.M., 35442).

Albatross station 4894; Eastern Sea, southwest of the Goto Islands; Ose Saki light bearing N. 41° E., 5 miles distant (lat. 32°33′00″ N., long. 128°32′10″ E.); 174 meters; temperature 13.28° C.; green sand, broken shells, and pebbles; August 9, 1906 (3, U.S.N.M., 35439).

Albatross station 4893; Eastern Sea, southwest of the Goto Islands; Ose Saki light bearing N. 29° E., 5.5 miles distant (lat. 32°32′00″ N., long. 128°32′50″ E.); 174–194 meters; temperature 13.28° C.; gray sand, broken shells and pebbles; August 9, 1906 [A. H. Clark, 1907] (1, U.S.N.M., 22622).

Albatross station 4903; Eastern Sea, southwest of the Goto Islands; Ose Saki light bearing N. 22° E., 6 miles distant (lat. 32°31′10″ N., long. 128°33′20″ E.); 195–254 meters; temperature 11.61° C.; gray sand and broken shells; August 10, 1906 [A. H. Clark, 1907] (1, U.S.N.M., 22624).

Albatross station 4936; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 21° E., 5.7 miles distant (lat. 30°54′40″ N., long. 130°37′30″ E.); 188 meters; temperature 15.89° C.; stones; August 16, 1906 (5, U.S.N.M., 35440, 35441, 35443, 36040; M. C. Z., 360).

Sagami Bay (lat. 34°59′ N., long. 139°34′ E.); 100 meters; Alan Owston, April 23, 1902 [A. H. Clark, 1908] (2, U.S.N.M., 35523).

Geographical range.—Southern Japan, from the Korean Straits to Sagami Bay.

Bathymetrical range.—From 100 to 195 (?254) meters; the average of 6 records is 181 meters.

Thermal range.—From 11.61° C. to 15.89° C.; the average of 5 records is 13.47° C.

Remarks.—The confusion in regard to this species was due to the occurrence on the specimen described as the type of *callista* of only a single cirrus which is unusually slender and has the earlier segments unusually long. At the time, in the absence of any other indications, this cirrus was considered as representing the cirri of the species as a whole. The cirri of the specimens included under the name *separata* resembled closely those of *Neometra multicolor* and were therefore very different from the single cirrus remaining on the type of *callista*. The true allocation of *separata* proved to be a matter of no little difficulty. In my first division of the genus *Calometra* in 1912 *separata* was assigned to the new genus *Pectinometra*. But it soon became evident that it could not remain here, and in 1915 I reassigned it to *Calometra*, restricted, considering it to differ from *C. callista* in having much shorter cirrus segments. On looking into the question again, however, I found on the type of *separata* a curious elongate unusually slender cirrus with very long earlier segments exactly resembling the only cirrus on the type of *callista*, so that now I have no hesitation in pronouncing the 2 supposed species to be in reality identical.

The association of this species with the other two species of the family occurring on the southern coast of Japan, *Neometra multicolor* and *Pectinometra flavopurpurea*, is discussed on page 383.

Family PTILOMETRIDAE Gislén

Spinifera group (in part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 211 (*Antedon macronema* only); for further references see part 4c.

Thalassometridae (in part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136; for further references see part 4c.

Thalassometrinae (in part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 2; for further references see part 4c.

Thalassomètres (in part) A. H. Clark, Bull. Mus. Hist. Nat., Paris, No. 4, 1911, p. 255.

Ptilometrinae A. H. Clark, Bull. Inst. Océanogr. Monaco, No. 294, 1914, pp. 7, 8 (temperature relations); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical ranges); No. 20, 1914, p. 582 (relation to temperature of habitat); vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range and its significance); Die Crinoïden der Antarktis, 1915, p. 132 (covering plates); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); Smithsonian Misc. Coll., vol. 65, No. 10, 1915, p. 41 and following (phylogenetic study); Unstalked crinoids of the *Siboga* Exped., 1918, p. 139 (in key; geographical and bathymetrical ranges), p. 140 (key to the included genera); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, p. 3.—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 85, 90.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 647; Treubia, vol. 14, livr. 2, 1933, p. 213.

Thalassometriden (in part) A. H. Clark, Die Crinoïden der Antarktis, 1915, p. 192.

Ptilometridae Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 25.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 103.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 23 (in key), p. 55.

Diagnosis.—A family of the superfamily Tropiometrida in which the ventral perisome of the pinnules is protected by fairly well-developed side- and covering-plates; P_1 resembles P_2 but is shorter and more slender; the muscular fossae on the radial articular faces, in sharp contrast to those of the Asterometridae and Thalassometridae, are very short, transversely linear (see Part 2, pp. 42–45, figs. 67, 68, p. 43, figs. 973, 974, pl. 2); and the centrodorsal is large, columnar, with the cirri arranged in 15 or 20 closely crowded and usually more or less irregular columns.

Geographical range.—Southern Australia northward to Dirk Hartog Island on the west coast and to the Clarence River on the east coast.

Bathymetrical range.—From the shore line down to 113 meters.

Remarks.—The species of the family Ptilometridae agree in general with the species of the family Asterometridae, but they differ radically in the very small size of the muscular fossae of the articular faces of the radials which are reduced to narrow transverse bands along the distal borders of the interarticular ligament fossae, as in the species of the family Calometridae, and less significantly in the structure of the centrodorsal which, though higher, suggests the centrodorsal of the Tropiometridae.

The family Ptilometridae includes only the genus *Ptilometra*.

History.—The subfamily Ptilometrinae was first recognized in 1914 as coordinate with the subfamily Thalassometrinae, the two subfamilies together making up the family Thalassometridae. The subfamily Ptilometrinae, which included the genera *Ptilometra*, *Asterometra*, and *Pterometra*, was distinguished from the subfamily Thalassometrinae, solely on the character of P_1, which is similar to P_2 but smaller, instead of larger and more or less differentiated as in the Thalassometrinae.

In 1924 Prof. Torsten Gislén accepted the family Thalassometridae with the subfamilies Ptilometrinae and Thalassometrinae, but he removed the genera *Asterometra* and *Pterometra* from the subfamily Ptilometrinae creating for them the new family Asterometridae which he placed in the subtribe Notocrinida under the Thalassometrida, the family Thalassometridae with the subfamilies Ptilometrinae and Thalassometrinae remaining in the subtribe Thalassometrida.

In 1934 Professor Gislén referred several times to the family Ptilometridae, but did not formally define it.

Genus **PTILOMETRA** A. H. Clark

Encrinus (part) Wilton, Tasmanian Journ. Nat. Sci., vol. 2, No. 7, 1843, p. 118.

Comatula (part) J. Müller, Monatsb. preuss. Akad. Wiss., 1846, p. 179.

Kallispongia (part) Wright, Proc. Roy. Irish Acad., ser. 2, vol. 2, 1877, p. 754.—Ridley, Zool. Rec. for 1877, 1878, Spongida, p. 6 Spong. (crinoidlike; doubtful if a sponge).

Comatula (*Antedon*) (part) P. H. Carpenter, Nature, vol. 15, 1877, p. 197.

Antedon (part) P. H. Carpenter, Nature, vol. 15, 1877, p. 197, and following authors.

Ptilometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 358 (diagnosis; genotype *Aleeto* [that is *Comatula*] *maeronema* J. Müller, 1841 [1846]); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (diagnosis; genotype *Comatula maeronema*); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (referred to the Tropiometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (same); Amer. Nat., vol. 42, No. 500, 1908, p. 541 (only known from Indo-Pacific-Japanese area); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (same); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 199 (discovered in the East Indies [refers to *Pterometra*]); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (side- and covering-plates more or less imperfectly developed; not found in the young); Zool. Anz., vol. 34, No. 11/12, 1909, p. 363 (tropical genus occurring in southern Australia); Vid. Medd. Naturh. Foren. København, 1909, p. 182 (amplification of the generic characters; radial articular facets); Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 130 (significance of distinctive characters); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (confined to southern Australia; closely related to *Pterometra* and *Asterometra* which represent it in the East Indies); Mem. Australian Mus., vol. 4, 1911, p. 728 (referred to the Thalassometridae), pp. 731 and 732 (in keys), p. 735 (key to the Australian species), p. 781 (original reference; characters; range); Crinoids of the Indian Ocean, 1912, p. 9 (does not occur in the area of maximum intensity of the East Indian fauna; confined to southern Australia), p. 10 (absent from Japan; reason), p. 24 (range), p. 42 (placed in the Thalassometridae), p. 189 (synonymy; type); Journ. Washington Acad. Sci., vol. 5, No. 1, 1915, p. 8 (confined to the Australian fauna); Die Crinoiden der Antarktis, 1915, p. 167 (range; closely related to *Asterometra* and *Pterometra*).—F. W. CLARKE and W. C. WHEELER, U. S. Geol. Surv. Prof. Paper 90–L, 1915, p. 195 (inorganic constituents of the skeleton); Prof. Paper 102, 1917, pp. 23 and following (same).—A. H. CLARK, Unstalked crinoids of the *Siboga* Exped., 1918, p. 140 (in key; range).—F. W. CLARKE and W. C. WHEELER, U. S. Geol. Surv. Prof. Paper 124, 1922, p. 20 (inorganic constituents of the skeleton [of *P. australis*]).—GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 85, 213.—H. L. CLARK, Rec. South Australian Mus., vol. 3, No. 4, May 9, 1928, p. 368; Mem. Mus. Comp. Zool., vol. 55, 1938, p. 44 (relation to *Aporometra*, new genus).—EKMAN, Tiergeographie des Meeres, 1935, p. 283.—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 55 (key to the included species; notes).

Geographical range.—Southern Australia northward to Dirk Hartog Island on the west coast and to the Clarence River on the east coast.

Bathymetrical range.—From the shore line down to 113 meters.

History.—In 1877 Prof. Edward Perceval Wright described a new genus of sponge that he called *Kallispongia*, with the genotype *Kallispongia archeri*, new species. Stuart O. Ridley, then recorder for the sponges in the Zoological Record, noted the similarity between this new genus (for which he suggested the emendation *Callispongia*) and the pentacrinoid young of comatulids and said it was doubtful whether it was a sponge. Professor Wright figured two individuals. One of these appears to be a pentacrinoid of *Compsometra lovéni*, and the other, which he calls a variety, may be a pentacrinoid of the east Australian species of this genus (*australis*). The genus *Kallispongia* may be disregarded as based upon unidentifiable larvae. Dr. P. H. Carpenter in 1888 remarked that "it is now clear that *Kallispongia*, Wright, is a real Comatulid larva, and not a mimetic Keratose sponge, as was at first supposed." He makes no further reference to it.

In a paper published on October 29, 1907, I described the new genus *Ptilometra*, giving as the genotype *Alecto macronema* J. Müller, 1841. Müller did not describe any *Alecto macronema* in 1841, but he did describe *Comatula macronema* in 1846, and this was the species I had in mind. My idea of *Comatula macronema* was derived entirely from Carpenter's description in the *Challenger* report supplemented by a study of various specimens all of which were from Sydney, or were without locality and probably from Sydney. The genus *Ptilometra* was therefore based upon the species herein called *australis*, wrongly identified as *macronema*. Under *Ptilometra* I listed *P. anthus* (A. H. Clark), *P. longicirra* (P. H. Carpenter), *P. macronema* (J. Müller), and *P. macropoda* (A. H. Clark). I noted that "I had at first isolated *Alecto macronema*, making it the type of *Ptilometra*, and including the other species in the genus *Asterometra* with *Antedon macropoda* as the type, but further study has led me to combine the two, at least for the present." In January 1908, in a key to the genera of the Antedonidae I included *Ptilometra* with the genotype *Comatula macronema* J. Müller, and also *Asterometra* with the genotype *Antedon macropoda* A. H. Clark. Since then there has been no change in the status of *Ptilometra*.

KEY TO THE SPECIES IN THE GENUS PTILOMETRA

a^1. Proximal cirrus segments as long as, or longer than, broad; cirrus sockets in more or less definite columns, three to each radial area; middle segments of the proximal pinnules half again to twice as long as broad; distal pinnules with the third and following segments longer than broad (western and southern Australia from Dirk Hartog Island southward and eastward to Port Phillip and Flinders Island; 0–113 meters)---------------------**macronema** (p. 396)

a^2. Proximal cirrus segments about twice as broad as long, or at least broader than long; cirrus sockets usually irregularly arranged; middle segments of the proximal pinnules not so long as broad; distal pinnules with the segments broader than long until the distal third (southeastern Australia from Port Phillip eastward and northward to the Clarence River; 0–86 [?110] meters)--**australis** (p. 403)

PTILOMETRA MACRONEMA (J. Müller)

Plate 40, Figure 206

[See also vol. 1, pt. 1, fig. 93 (lateral view), p. 153; fig. 360 (cirrus), p. 295; pt. 2, figs. 857, 858 (side- and covering-plates), p. 412.]

Comatula macronema (Valenciennes, MS.) J. Müller, Monatsb. preuss. Akad. Wiss., 1846, p. 179 (description; King George's Haven); Abh. preuss. Akad. Wiss., 1847, 1849, p. 258 (redescribed).—Dujardin and Hupé, Histoire naturelle des Zoophytes, Echinodèrmes, 1862, p. 203 (description; Australia).—A. H. Clark, Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (genotype of *Ptilometra*); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 244 (identity); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (history); Mem. Australian Mus., vol. 4, 1911, p. 712 (history); Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Comatula (*Antedon*) *macrocnema* P. H. Carpenter, Nature, vol. 15, 1877, p. 197.

Antedon macrocnema P. H. Carpenter, Nature, vol. 15, 1877, p. 197; Proc. Roy. Soc., vol. 28, 1879, p. 386; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (listed as an *Antedon*).

Antedon macronema Bell, Proc. Zool. Soc. London, 1882, pp. 533, 534 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 733, 746 (correction of Bell's specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 212 (record from King Georges Sound, quoted from Müller, only).—Studer, Die Forschungsreise S. M. S. *Gazelle* in der Jahre 1874–6, vol. 3, Zool. und Geol., 1889, p. 185 (Dirk Hartog Island; habits and color in life).—P. H. Carpenter, Proc. Roy. Soc. Victoria, new ser., vol. 2, 1890, p. 135 (Port Phillip).—Hartlaub, Nova Acta Acad. German, vol. 58, No. 1, 1891, p. 75 (only species of the *Spinifera* group not from deep water).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. Clark, Mem Australian Mus., vol. 4, pt. 15, 1911, pp. 715, 716 (identification of references); Crinoids of the Indian Ocean, 1912, pp. 34, 37, 104, 179 (identification of references); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 84 (B. M., MS. = *Zygometra microdiscus* + *Oreometra mariae* + *Ptilometra mülleri* [= *australis*]).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in *Spiniferia* group; history).

Antedon mucronata Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).

Alecto macronema A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 358 (error for *Comatula macronema* J. Müller, 1846).

Ptilometra macronema A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359 (listed); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 244 (= *Comatula macronema* J. Müller), p. 255 (Australia; description; same as *P. dorcadis;* range), fig. 1B, p. 256 (cirrus of a specimen from Kangaroo Island); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, pp. 442–444 (range), p. 449 (range of *Comatulella brachiolata* falls within the range of this species), p. 460 (6-rayed specimen from Kangaroo Island), p. 461 (new localities; description of young specimens; discussion of *Himerometra paedophora*, which is the young of *P. mülleri* [*australis*]), pp. 465, 466 (association with other species); Mem. Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia), p. 722 (confined to southern Australia; range), p. 724 (Turtle Bay, Dirk Hartog Island), p. 735 (in key), p. 781 (annotated synonymy; characters; 6-rayed specimen; history;

description of the types at Paris); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 382 (specimen from Koombana Bay in U. S. N. M.), p. 384 (includes *dorcadis*), p. 404 (southwestern Australia; Dirk Hartog Island, 7 fms.); Crinoids of the Indian Ocean, 1912, p. 9 (confined to southern Australia), p. 30 (=*Comatula macronema* J. Müller), p. 34 (=*Antedon macronema* P. H. Carpenter, 1888, in part), p. 189 (synonymy; range); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 42 (published references to specimens in the B. M.; localities).—Alexander, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 108 (off Geraldton).—A. H. Clark, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 115 (collected by the *Endeavour* in Western Australia; southern Australian species), p. 131 (off Geraldton, 25–40 fms., very abundant; characters); Die Crinoiden der Antarktis, 1915, p. 167 (range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, pp. 226 and following (detailed account of the distribution).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 5 (characteristic of South Australian subregion), p. 23 (new localities).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, No. 2, 1916, p. 236 (southwestern Australia, No. 5959; Dirk Hartog, No. 2964).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 42 (listed from Tasmania).—H. L. Clark, Rec. South Australian Mus., vol. 3, No. 4, May 9, 1928, pp. 362, 368 (Encounter Bay, St. Vincent Gulf, Spencer Gulf, off Althorpe Island, and specimens without locality).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 55 (in key), p. 56 (records).

Ptilometra dorcadis A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 39 (description; Turtle Bay, Dirk Hartog Island, 7 fms.); Zool. Anz., vol. 34, No. 11/12, 1909, p. 368 (same locality); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 437 (history; synonym of *macronema*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (synonym of *macronema*).

Diagnostic features.—In its general appearance this species is more robust than *P. australis;* the centrodorsal is thicker and more columnar, the cirri are stouter basally and longer with the longest segments as long as or slightly longer than broad instead of from twice as broad as long to about as long as broad; and the proximal pinnules are more enlarged and longer than in *P. australis* with longer segments of which the central are from half again to twice as long as broad instead of broader than long, or at least not longer than broad. In the middle pinnules the third and following segments are always longer than broad, and the distal are considerably elongated. The cirrus sockets are arranged in three or sometimes four columns on the centrodorsal. Both this species and *P. australis* are variable and most of the differential characters show more or less overlapping.

Description.—The centrodorsal is columnar, 6.5 mm. in diameter at the base and 3 mm. high, with the sides slightly convex and the large bare polar area flat, 5 mm. in diameter. The cirrus sockets are closely crowded, arranged in 15 columns of two or three each, the sockets in each column tending to alternate with those in the neighboring columns.

The cirri are XXXV, 93, from 55 mm. to 60 mm. in length, stout basally but tapering distally. The first segment is very short, about four times as broad as long, and those following gradually increase in length to about the eighth to thirteenth, which is about as long as broad, then remain similar or become very slightly longer than broad until about the thirty-fifth, after which they very gradually decrease in length, the terminal 40 or so being about twice as broad as long. The proximal segments are smooth, without dorsal or ventral spines. At about the thirty-fifth the median portion of the distal dorsal border begins to become prominent, this feature gradually becoming more pronounced resulting in high carinate dorsal spines on the later segments. The opposing spine is large, prominent, and blunt, directed distally, arising from the entire dorsal surface of the penultimate segment and in height equal to the distal width of that segment. The terminal claw is nearly as long as the two preceding segments, slender and only slightly curved.

The disk and the brachial ambulacra are naked. Side and covering plates are well developed in the distal half of the pinnule ambulacra.

The ends of the basal rays are visible as rhombic tubercles in the interradial angles of the calyx, but do not project above the general surface of the radials.

The radials are rather prominent, nearly four times as broad as long, gently concave distally. The IBr_1 are about two and one-half times as broad as long, with their straight lateral edges in apposition with those of their neighbors. The IBr_2 (axillaries) are rhombic, about twice as broad as long, the lateral edges about half as long as those of the IBr_1. The IIBr series are 2, developed on the right side of 3 of the IBr series, on both sides of one, and absent from the fifth. The division series and first 2 brachials are broad and outwardly have a uniformly produced narrow border by which they are in lateral apposition, though they are not laterally flattened.

The 15 arms are about 55 mm. long. The brachials in general resemble those of *P. australis*, but in the distal half of the arm they are sharply rounded dorsally instead of sharply carinate, the long overlapping spines of that species being represented by insignificant tubercles on the median portion of the distal edge of each segment.

Syzygies occur between brachials 3+4, again between brachials 12+13 or 13+14, and distally at intervals of 5–7 (usually 6 or 7) muscular articulations.

P_1 is 8 mm. long, stiff, rather small, with 9 segments of which the first is not quite so long as broad, the second is slightly longer than broad, the third is twice as long as its proximal width, and the remainder are greatly elongated, except for the minute terminal segment. P_2 is 12 mm. long, much stouter than P_1, with 9 segments which are similar in their proportions to those of P_1. P_3 is the longest pinnule on the arm, 13 mm. or 14 mm. in length, with 11 segments which are of similar proportions to those of the preceding pinnules. P_4 is intermediate in length between P_1 and P_2 11 mm. long, with 11–12 segments of which the first is twice as broad as long, the second is about as long as broad, and the following gradually increase in length, becoming greatly elongated distally. The pinnules succeeding are similar to about the middle of the arm, beyond which point they become more slender, slightly less stiff, and decrease in length distally to about 9 mm. P_1 is occasionally absent, in which event P_2 is much smaller than usual.

The color in alcohol is dull purple.

Notes.—The preceding description is based upon the specimen from Dirk Hartog Island, the type of *Ptilometra dorcadis*.

The largest specimen presumably from the vicinity of Perth has 19 arms. The centrodorsal is thick-discoidal or columnar with the dorsal pole very slightly concave, 6 mm. in diameter. The cirri are XXXV, 89–106, the longest 65 mm. long. They are stout basally but taper in the proximal third and become slender in the distal half. The first segment is short and those succeeding gradually increase in length becoming nearly or quite as long as broad on the tenth or eleventh, remaining of the same proportions to nearly the end of the proximal half, then gradually decreasing in length so that the segments in the distal third are about twice as broad as long. With the shortening of the segments distally the distal dorsal edge begins to become produced, this production on the short distal segments forming a high narrow carination or blunt dorsal spine. The color is light purple, the cirri slightly darker and becoming very dark distally.

Another specimen from the same locality has also 19 arms 60 mm. long. As in the preceding, the cirri are arranged in 15 closely crowded columns, two or three to a column; the longest have 81–89 segments and reach a length of 55–60 mm.

A third specimen has 20 arms, the cirri with a maximum of 75 segments. The other specimens have 19 arms. One of them has a single IIIBr 2 series developed externally. In the smaller specimens the longest cirrus segments are slightly longer than broad.

The 10 specimens from off Geraldton are all of medium size, the arms being 45–55 mm. long from the radials, and the longest cirri have 69–78 segments and are about 45 mm. long. Six have 20 arms, two have 19, one has 16, and one has 14. The color in life was recorded as purple, the cirri red. In alcohol the color is yellowish brown, the cirri becoming deep purple in the outer half.

The four specimens collected by Quoy and Gaimard upon which Müller based his *Comatula macronema* (adopting a manuscript name bestowed upon them by Valenciennes) have 13–18 arms. The cirri are very large with the segments in the proximal half slightly longer than broad.

The specimen from the Great Australian Bight in the Museum of Comparative Zoology (No. 713) has 25 arms.

Regarding the specimens in the South Australian Museum Dr. Hubert Lyman Clark said that this, "the commonest Australian crinoid," is represented by 47 specimens from Encounter Bay, St. Vincent Gulf, Spencer Gulf, off Althorpe Island (collected by Sir Joseph Verco in 1892) and at least one unknown locality. The largest specimens have 25–31 arms about 70 mm. to 80 mm. long, and more than LX cirri which may be 57 mm. long and have 87 segments. There are 7 very small specimens with 10 arms, and the cirri XVIII–XX, nearly or quite as long as the arms (about 20 mm.) with 40 or more segments.

The two specimens in the Museum of Comparative Zoology from 40 miles west of Kingston (No. 714) have 15 and 22 arms. The middle pinnules appear to be longer in this species than in *P. australis* and much more spiny. The segments fit so closely that the pinnules as a whole have the appearance of thorns. There is a considerably greater difference in the appearance of the proximal and distal half of the arms than in *australis*.

One of the specimens from Kangaroo Island has 32 arms 55–60 mm. long, and the cirri about L, 82–88, 65 mm. long. The centrodorsal is 6 mm. high and 8 mm. in diameter. The IIIBr series are developed externally in 2,1,1,2 order as is always the case in this group. The lower pinnules are large and long.

One of the specimens from Port Phillip is a fine large example with 18 arms resembling those in the Australian Museum collection from Kangaroo Island. Another is similar. The third is young.

Abnormal specimen.—One of the specimens from Kangaroo Island is 6-rayed with 5+4+3+4+6+4=26 arms. The centrodorsal is 5 mm. high and 8 mm. in diameter. There are about L cirri.

Color in life.—Professor Studer noted that the specimen collected at Dirk Hartog

Island had flesh-colored arms and yellow pinnules. Mr. Alexander's notes gave the color of the specimens dredged off Geraldton as purple, the cirri red.

Localities.—Turtle Bay, Dirk Hartog Island, Western Australia; 16 meters; sand with eel-grass (*Zostera*); *Gazelle*, April 23, 1875 [Studer, 1889; A. H. Clark, 1909, 1911, 1912; Hartmeyer, 1916] (1, Berl, Mus., 2964).

?Vicinity of Perth, Western Australia; Hamburg Southwest Australian Expedition, 1905 [A. H. Clark, 1911] (6, U. S. N. M., 35568; Berl. Mus.).

Off Geraldton, Western Australia; 46–73 meters; *Endeavour*, June 1912 [A. H. Clark, 1914] (10, U. S. N. M., 35561; Western Australian Mus.).

Southwestern Australia [A. H. Clark, 1912; Hartmeyer, 1916] (9, Berl. Mus., 5959).

King George's Sound, southwestern Australia; MM. Quoy and Gaimard, 1829 [J. Müller, 1846, Dujardin and Hupé, 1862; P. H. Carpenter, 1877, 1879, 1883, 1888; Bell, 1882; Hartlaub, 1891, 1912; A. H. Clark, 1911 (in part as Nouvelle-Hollande), 1912] (4, P. M.).

Great Australian Bight, about long. 131° E.; 113 meters; *Endeavour*, 1909–1914 [H. L. Clark, 1916] (1, M. C. Z., 713).

Spencer Gulf, South Australia; Sir Joseph Verco, 1892 [H. L. Clark, 1928].

Althorpe Island, at the entrance to Spencer Gulf; Sir Joseph Verco, 1892 [H. L. Clark, 1928].

Kangaroo Island, South Australia [A. H. Clark, 1911, 1912] (2, U. S. N. M., 36160; Australian Mus.).

Sanders Bank, off Kangaroo Island; 51 meters; *Endeavour*, 1909–1914 [H. L. Clark, 1916].

St. Vincent Gulf, South Australia; Sir Joseph Verco, 1892 [H. L. Clark, 1928].

Encounter Bay, South Australia; Sir Joseph Verco, 1892 [H. L. Clark, 1928].

Lacépède Bay, 40 miles west of Kingston, South Australia; 55 meters; *Endeavour*, 1909–1914 [H. L. Clark, 1916] (4, M. C. Z., 714).

South Australia [A. H. Clark, 1913] (2, B. M.).

Southern Australia [A. H. Clark, 1911].

Port Phillip, Victoria [P. H. Carpenter, 1890; A. H. Clark, 1912, 1913] (3, B. M.).

Southeast of Flinders Island, north of eastern Tasmania; 68 meters; *Endeavour*, 1909–1914 [H. L. Clark, 1916; A. H. Clark, 1918 (as Tasmania)].

No locality [H. L. Clark, 1928].

Geographical range.—From Flinders Island and Port Phillip, Victoria, westward and northward to Dirk Hartog Island, Western Australia.

Bathymetrical range.—From low tide mark down to 113 meters.

Occurrence.—Professor Studer said that at Turtle Bay, Dirk Hartog Island, this species was found clinging to seaweed. It was noted by Mr. Alexander as "very abundant" off Geraldton.

History.—This species was first described in 1846 by Prof. Johannes Müller from four specimens in the Paris Museum that had been collected by Quoy and Gaimard in 1829 at King George's Sound, southwestern Australia, during the expedition of the *Astrolabe* under the command of J. Dumont d'Urville (1826–29). With these specimens Müller found the manuscript name *Comatula macronema* that had been given them by Valenciennes, under which he described them.

He redescribed the species in 1849 in the following terms: A small comatulid with 13–15 arms and a rounded centrodorsal with XXX and more exceedingly long cirri with 60–70 segments which toward the end of the cirri develop a tubercle. From the five arm stems of three radials (i. e., the radial and the IBr 2 series) are developed usually 3 arms so that an arm stem is at first divided into a thicker and a thinner part; the thicker part on the second segment or brachial axillary ($IIBr_2$) divides again into 2 arms. Usually 3 brachials between the syzygial pairs of the arms. The brachials are at first rounded, but soon become compressed and very strongly keeled, their ridges developed toward the aboral edge into an aborally directed spine. The first outer pinnule is small, those following are large and diminish at first gradually. Color dingy reddish. Size up to 6 inches (which would mean an arm length of about 75 mm.). King Georges Haven.

Dujardin and Hupé in 1862 published a translation of Müller's description.

In 1877 Dr. P. H. Carpenter wrote that of the two specimens of *Comatula* (*Antedon*) *macrocnema* in the Paris Museum one has a hemispherical centrodorsal basin just like that of *Comatula* (*Antedon*) *eschrichtii* (=*Heliometra glacialis*), while in the other it is a short pentagonal or nearly circular column on which the cirri are disposed in four alternating rows precisely as in *Solanocrinus*.

In 1879 Dr. Carpenter listed *Antedon macrocnema*, referring the species to the genus *Antedon* in contrast to *Actinometra*.

Prof. F. Jeffrey Bell in 1882 proposed a specific formula for *Antedon macronema* which was amended by Carpenter early in the year following.

Carpenter's account of *Antedon macronema* in the *Challenger* report in 1888 is based wholly upon *Ptilometra australis*, as he had no specimens of *P. macronema*. The only specimens of *P. macronema* known at that time were those described by Müller; Carpenter's locality record King George's Sound refers to these.

In 1889 Prof. Theophile Studer gave brief notes on the habits and color of a comatulid dredged by the German steamer *Gazelle* in Turtle Bay, Dirk Hartog Island. The specimen referred to was subsequently described under the name *Ptilometra dorcadis*.

In 1890 Carpenter recorded, as *Antedon macronema*, several specimens from Port Phillip, Victoria. This is the second record for the species—or the third if we include Professor Studer's unidentified comatulid.

In 1891 Dr. Clemens Hartlaub wrote, following Carpenter, that *Antedon macronema* from the east coast of Australia is an exception to the rule that species of the *Spinifera* group occur in deep water. The species occurring on the east coast of Australia is *P. australis*, and the specimen listed from Sydney belongs to this form.

In 1907 I described the new genus *Ptilometra* with the type species *Alecto macronema* J. Müller, 1841, an error for *Comatula macronema* J. Müller, 1846, and listed the species as *Ptilometra macronema*. In 1909 I described *Ptilometra dorcadis*, which was based on the specimen mentioned by Professor Studer in 1889, and listed the species in a report upon the comatilids collected by the *Gazelle*. In my report upon the crinoids of the Hamburg Southwest-Australian Expedition, 1905, published in 1911, I recorded and gave notes on six specimens presumably from the vicinity of Perth. The specimens recorded as *Ptilometra macronema* from Koombana Bay are in reality *Aporometra occidentalis*. In 1910 I examined the types of Müller's *Comatula macro-*

nema in Paris, and in a report on the crinoids of the Paris Museum published in 1911 I wrote: "Cette espèce est indubitablement la même que la *Ptilometra dorcadis* que j'ai décrite de l'île Dirk Hartog (Australie occidentale). Elle se trouve dans l'Ouest et le Sud de l'Australie, de l'île Dirk Hartog jusqu'á Port Phillip et Kangaroo Island en South Australia. Une deuxième espèce, dont tous les articles des cirres sone très courts, se trouve sur les côtes de New South Wales. Je l'ai nommée *Ptilometra Mülleri*." I gave figures of the cirri of *Ptilometra macronema* and of *P. mülleri*. In my report on the crinoids of the Hamburg Southwest-Australian Expedition, 1905, published in 1911, I recorded and gave notes on six specimens presumably from the vicinity of Perth. At the same time three specimens from Koombana Bay were described which were said to be young individuals of this species. In reality, however, they are specimens of *Aporometra occidentalis*. In a memoir on the recent crinoids of Australia published in 1911 I gave a detailed comparison between *Ptilometra macronema*, under which I placed *P. dorcadis* as a synonym, and the species from the eastern coast of Australia which I called *P. mülleri*. I recorded and gave notes on two specimens from Kangaroo Island. Additional localities listed for the species were King George Sound, Dirk Hartog Island, and Port Phillip.

Dr. Clemens Hartlaub in 1912 in a discussion of Carpenter's *Spinifera* group mentioned *Antedon macronema* from King George's Sound, Port Jackson, and Port Stephens. The species occurring at the two last localities in *P. australis*.

In a paper on the crinoids of the Museum für Naturkunde in Berlin published in 1912 I listed nine specimens of *Ptilometra macronema* from "Southwestern Australia" and one (the type of *P. dorcadis*) from Dirk Hartog Island. In my memoir on the crinoids of the Indian Ocean published in 1912 the synonymy and the geographical and bathymetrical ranges of *Ptilometra macronema* were given. In the synonymy is included *Antedon wilsoni* Bell, which is *Aporometra wilsoni*. In a paper on the recent crinoids in the British Museum published in 1913 I listed three specimens from Port Phillip and two labeled "South Australia." Seven of the specimens listed from Port Phillip, the types of Bell's *Antedon wilsoni*, represent *Aporometra wilsoni*. In 1914 I recorded and gave notes on 10 specimens of *Ptilometra macronema* that had been dredged by the *Endeavour* in June 1912 off Geraldton in 25–40 fathoms, and at the same time W. B. Alexander included the species in his list of the Western Australian echinoderms in the Western Australian Museum. In discussing the crinoid fauna of southern Australia in my memoir on the crinoids of the Antarctic published in 1915 I said that *Ptilometra macronema* "findet sich von Dirk Hartog-Eiland, Westaustralien, südlich und östlich bis Port Phillip, Victoria und bei Kangaroo-Eiland in 12,5–50 m (6,9–28 Faden) Tiefe." In 1915 I gave a detailed account of the distribution of this species on the Australian coasts, and in 1916 Dr. Robert Hartmeyer published the catalog numbers of the specimens in the Museum für Naturkunde in Berlin.

In 1916 Dr. Hubert Lyman Clark recorded 10 specimens of *Ptilometra macronema* from four localities in southern Australia where they had been collected by the Australian Federal Fisheries Investigation Ship *Endeavour* between 1909 and 1914. In 1918 I referred to one of these localities (southeast of Flinders Island) as "Tasmania." In 1928 Dr. Clark recorded 47 specimens of this species, which he called "the commonest Australian crinoid," from various localities in the vicinity of Spencer Gulf and Encounter Bay where they had been collected by Sir Joseph Verco in 1892 and from "at least one unknown locality." He also discussed the relationship between *Ptilometra* and *Himerometra paedophora* (=*Aporometra paedophora*) maintaining that the two were quite distinct.

PTILOMETRA AUSTRALIS (Wilton)

PLATE 40, FIGURE 207

See also vol. 1, pt. 1, fig. 12 (dorsal view of radial pentagon), p. 65; figs. 187 (dorsal view of centrodorsal), 188 (lateral view of centrodorsal), p. 235; figs. 267, 271 (ventral view of centrodorsal), p. 259; fig. 361 (cirrus), p. 295; fig. 483 (dorsal view of radial pentagon), p. 365; pt. 2, figs. 67, 68 (radial pentagon), p. 43; figs. 165, 166 (division series and arm bases), p. 86; fig. 204 (lateral view), p. 139; fig. 252 (brachials), p. 199; fig. 280 (pinnules), p. 213; fig. 316 (proximal pinnules), p. 227; fig. 343 (distal pinnules), p. 229; figs. 508–511 (pinnule tips), p. 276; figs. 738–742 (disk), p. 349; pl. 2, figs. 973, 974 (radial pentagon); pl. 53, fig. 1346 (lateral view).]

Encrinus australis Wilton, Tasmanian Journ. Nat. Sci., vol. 2, No. 7, 1843, p. 118 (description; Hunter River, Newcastle, NSW.).—Pleydell, L'Institut, Aug. 13, 1845, p. 292 (partial reprint of the preceding).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, part 32, 1884, p. 427 (from the preceding).—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, pp. 711, 712 (account from "Pleydell" reprinted), p. 797.—Etheridge, *in* Clark, Mem. Australian Mus., vol. 4, 1911, pp. 803–804 (Wilton's account reprinted).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 56 (history and identity; from A. H. Clark, *in litt.*).

Kallispongia archeri var. Wright, Proc. Roy. Irish Acad., ser. 2, vol. 2, 1877, p. 754 (in part; Australia), pl. 40, fig. 3.—Ridley, Zool. Rec. for 1877, 1878, Spongida, p. 6 Spong. (crinoidlike; doubtful if a sponge).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 90.—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, p. 713 (history; identified as probably the larvae of *Compsometra lovéni* and *Ptilometra mülleri* [*australis*]).

Comatula (*Antedon*) *macronema* (part) P. H. Carpenter, Nature, vol. 15, 1877, p. 197.

Antedon macronema P. H. Carpenter, Nature, vol. 15, 1877, p. 197.—Bell, Proc. Zool. Soc. London, 1882, pp. 533, 534.—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 733 and following (discussion of Bell's method of formulation and corrected formulae); *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 212 (description; Port Jackson, 30–35 fms.; Port Stephens [record from King George's Sound=*macronema*]); pl. 4, figs. 3, *a–d*; pl. 38, figs. 4, 5.—Whitelegge, Journ. Roy. Soc. New South Wales, vol. 23, 1889, p. 198 (near Sow and Pigs reef, Port Jackson).—P. H. Carpenter, Proc. Roy. Soc. Victoria, new ser., vol. 2, 1890, p. 135 (Port Phillip).—MacMunn, Quart. Journ. Micr. Sci., 1890, p. 55 (pigment).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 75 (only species of *Spinifera* group not from deep water), p. 78 (Sydney; extraordinary variation in the position of the first brachial syzygy), p. 113 (in Göttingen Mus.).—Bell, Proc. Zool. Soc. London, 1894, p. 399 (irregular position of the syzygies in Hartlaub's specimen), p. 400 (comparison with *Antedon vicaria*).—Hertwig, Lehrb. Zool., Jena, 1897, p. 303, figs. 285, 287C (from Carpenter).—Emery, Compendio Zool., 1899, p. 218, fig. 252*a* (from Carpenter).—Minckert, Arch. Naturg., Jahrg. 71, vol. 1, No. 1, 1905, p. 200 (with regenerating ray).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—Hertwig and Kingsley, Man. Zool., 1909, p. 339, fig. 321 (after P. H. Carpenter).—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, pp. 715, 716 (identification of references); Crinoids of the Indian Ocean, 1912, pp. 34, 37, 104, 179 (identification of references); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 84 (identification of references).

Antedon macrocnema P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 386; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (listed as an *Antedon*), p. 61 (centrodorsal); Journ. Linn. Soc. (Zool.), vol. 15, 1880, p. 198 (centrodorsal and radial articular faces), p. 215 (has both a rosette and basal rays), pl. 12, fig. 25, *a–c* (Sydney harbor; centrodorsal and radial articular faces); Quart. Journ. Geol. Soc., 1880, p. 41 (character of centrodorsal), p. 42 (articular faces of the radials), p. 54 (centrodorsal compared with that of *Antedon prisca*).

Antedon mauonema Bell, Proc. Linn. Soc. New South Wales, vol. 9, 1884, 1885, p. 497 (Port Stephens).

Antedon mucronata (part) Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1580 (listed).

Ptilometra macronema A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359 (in part; listed); vol. 52, pt. 2, 1908, pp. 225, 226 (compared with *P. trichopoda*); Proc. Biol. Soc. Washington, vol. 22, 1909, pp. 39–41 (compared with *P. dorcadis*); Zool. Anz., vol. 34, No. 11/12, 1909, p. 363 (Australian species belonging to a tropical genus).—H. L. Clark, Mem. Australian Mus., vol. 4, pt. 11, 1909, p. 525 (all the individuals of *Himerometra paedophora* were found tightly clinging by their cirri to the pinnules and cirri of the larger specimens of this species), p. 527 (new localities).—A. H. Clark, Ann. Mag. Nat. Hist., ser. 8, vol. 5, 1910, p. 361 (deficient side- and covering-plates the result of a shallow-water habitat).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 5 (characteristic of southern Australian subregion), p. 23 (new localities).

Comatula macronema A. H. Clark, Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (genotype of *Ptilometra;* this is *macronema* of Carpenter, 1888=*australis*).

Ptilometra mülleri A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 41 (new name for the species of *Ptilometra* found at Sydney if it should prove to be different from the form found at King Georges Haven); Bull. Mus. Hist. Nat., Paris, 1911, No. 4, p. 256 (compared with *macronema;* range), fig. 1A (cirrus of a specimen from Sydney harbor); Fauna Südwest Australiens, vol. 3, Lief. 13, 1911, p. 437 (history; comparison with *macronema*), p. 442 (south Australian species occurring north to Port Phillip on the west and Broughton Islands on the east), p. 443 (range in east); p. 449 (range of *Comatulella brachiolata* does not enter range of this species), p. 462 (*Himerometra paedophora* is the young of this species); Mem. Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia), p. 718 (history), p. 722 (range), p. 735 (in key), p. 783 (synonymy; characters; localities), p. 785 (remarks); Crinoids of the Indian Ocean, 1912, p. 9 (range), pp. 34, 37 (identity), p. 189 (synonymy; range).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 90–D, 1914, p. 34 and following (inorganic constituents of the skeleton).—A. H. Clark, Die Crinoiden der Antarktis, 1915, p. 167 (range); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1915, p. 226 and following (detailed account of distribution).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt 1, 1916, p. 4 (range), p. 24 (localities).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 102, 1917, p. 20 and following (inorganic constituents of the skeleton).—Mortensen, Studies in the development of crinoids, 1920, p. 4 (young carried on the cirri [error for pinnules]; refers to *Aporometra paedophora*).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Paper 124, 1922, p. 17 (inorganic constituents of the skeleton).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 28, footnote 1, 79, 194, fig. 175, p. 98 (articulation of P_4); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.—Pope, Australian Mus. Mag., vol. 8, No. 12, 1945, pp. [iii], 407, fig. on cover.—H. L. Clark, Echinoderm fauna of Australia, 1946, pp. 55, 56 (history).

Ptilometra muelleri A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 43 (references to specimens in the B. M.; localities).

Ptilometra australis (A. H. Clark, *in litt.*) H. L. Clark, Echinoderm fauna of Australia, 1946, p. 55 (localities).

Diagnostic features.—This species is more delicate and slender than *P. macronema;* the centrodorsal is less thickened and columnar with the cirrus sockets less regularly arranged; the cirri are shorter and more slender, especially distally, with short proximal segments of which the longest in fully developed individuals are about twice as broad as long, though in small ones they may be nearly or quite as long as broad; the proximal pinnules are more slender and shorter, and all the pinnules have proportionately considerably shorter segments.

Description of a specimen from Sydney (see Part 2, pl. 53, fig. 1356; U.S.N.M., 17863).—The centrodorsal is short columnar, 7 mm. broad at the base, 6.5 mm. broad at the dorsal pole, and 4 mm. high. The cirrus sockets are arranged in 20 regular closely crowded columns of 2–4 (usually 3) sockets each, 4 columns to each radial area.

The cirri are LX, 70–80, the longest 50 mm. long. A few cirri about the broad flat dorsal pole are short, 30 mm. long with 57 segments. In the fully developed cirri the first segment is very short, usually about four times as broad as long, and those following gradually increase in length to about the tenth or twelfth which, with those following, are from twice as broad as long to nearly or even quite as long as broad; but in nearly all the cirri the longest segments are markedly broader than long. In the distal half of the cirri the segments slowly decrease in length so that those in the terminal third are about twice as broad as long or even shorter. The cirri are moderately stout basally, tapering very slightly in the proximal fourth and again in the distal third, and more rapidly in the last 20 segments, so that the terminal portion, which is strongly recurved, is less than half as broad as the base. Shortly after the middle of the cirri the segments develop a rounded median dorsal carination which, scarcely evident at first, slowly develops into a rather broadly rounded median dorsal ridge which gradually narrows and on the small terminal segments becomes a sharp median dorsal keel with a strongly convex crest abruptly truncated distally which is low, in height never so much as one quarter the width of the segments bearing it and usually much less; this keel becomes lower on the distalmost segments. The opposing spine is triangular with the apex, which is more or less rounded, terminal, arising from the entire dorsal surface of the penultimate segment, in height about equal to half the width of that segment. It is much larger than the dorsal processes on the segments preceding. The terminal claw is longer than the penultimate segment, evenly tapering and gently curved.

The ends of the basal rays are visible interradially as dorsoventrally elongate tubercles.

The radials are very short, gently curved, usually about twice as long in the interradial angles as in the midradial line, with the proximal border often more or less deeply notched by the upper edge of the cirrus sockets of the proximal row. The IBr$_1$ are short, four to five times as broad as long, with the proximal and distal edges nearly straight and parallel, and the lateral edges straight and parallel and in contact with those of their neighbors. The central portion of the dorsal surface is broadly and slightly swollen, the distal border is very slightly and broadly concave in the central portion, and the lateral borders are sharply flattened laterally, though as the ossicle is very thin this is scarcely noticeable. The IBr$_2$ (axillaries) are twice as broad as long with the broadly truncated lateral angles half as long as the sides of the IBr$_1$ and in apposition with those of their neighbors. The central portion is slightly elevated and the central part of the proximal border may be slightly and broadly convex. The two distal edges are straight or nearly so and make with each other more than a right angle. The IIBr series are 2 and in general resemble the IBr series, but the IIBr$_1$ is relatively larger than the IBr$_1$. The IIBr$_1$ is wedge-shaped, with the outer edge about twice as long as the inner, nearly three times as broad as the length of the outer edge. The inner edges of adjacent IIBr$_1$ are in close contact and the outer edges are straight, sharply, though thinly, flattened, and in contact with those of their neighbors. The IIBr$_2$ (axillaries) are about as long as the outer edge of the IIBr$_1$ or slightly longer. The lateral angles are truncated, forming short sides of about the same length which are less than half as long as the inner edge of the $IIBr_1$. The distal edges are gently concave and the anterior angle is approximately a right angle. The IIIBr series resemble the IIBr series, but the component segments are relatively longer. All the IIIBr series are developed externally.

The 23 (5+6+4+4+4) arms are 80 mm. long from the radials. The first brachials are half again as long exteriorly as interiorly, and about twice as broad as the median length. The proximal edge is gently convex and the distal edge is much more strongly concave. The outer and inner edges are straight and the latter are in close contact with the adjacent first brachials. The outer sides are sharply and rather broadly flattened. The second brachials are of about the same size as the first, but the distal edge is straight and at right angles to the longitudinal axis of the arm, and the proximal edge is strongly convex. The first syzygial pair (composed of brachials 3+4) is from half again to about twice as broad as long, with the proximal and distal edges parallel; the hypozygal is usually slightly larger than the epizygal. The next two brachials are oblong, between three and four times as broad as long, after which the brachials become wedge-shaped and almost immediately triangular, more than twice as broad as the length of the longer edge. After the middle of the arm the brachials again become wedge-shaped and slowly elongate so that distally they are about as long as broad. The terminal three or four brachials are very small, without pinnules, and are recurved ventrally between the outermost pinnules which extend for 3 mm. or more beyond them. In the basal portion of the arms the dorsal surface is broadly and evenly rounded. After about the fifteenth brachial the central portion of the dorsal surface gradually begins to rise, soon becoming a gablelike ridge. As the arm gradually becomes compressed laterally this ridge rises into a carination that develops into a high, broad, curved spine the distal end of which overlaps the base of the succeeding brachial.

The distribution of the syzygies is irregular. The first syzygy is usually between brachials 3+4, but may be between brachials 4+5 or 5+6, or even as far out as 18+19. The second syzygy is from between brachials 12+13 to between brachials 20+21. The distal intersyzygial interval is from 3 to 7, usually 5 or 6, muscular articulations.

P_1 is 6.5 mm. long with 11 segments, tapering rather rapidly in the first four, thence much more gradually. The first segment is more or less semicircular, somewhat broader than long. The second is slightly broader than long and tapers slightly distally. The third is longer than broad and tapers distally. The fourth is twice as long as the median width with the distal end somewhat more than half as broad as the proximal. The following segments are cylindrical, from two and one-half to three times as long as broad except for the terminal, which is a mere button. P_2 is 11 mm. long with 14 segments and tapers evenly and slowly from the base until near the tip. The first segment is nearly twice as broad as long, the second is about as long as broad, the third is very slightly longer than broad, and those following very slowly increase in length so that the twelfth is about twice as long as broad and the thirteenth somewhat longer and tapering distally. The terminal segment is minute. From the third onward the segments are sharply triangular in cross section so that the pinnule shows a sharp ridge or crest along the outer side. P_3 is 11.5 mm. long with 14 segments and resembles P_2. P_4 is 11 mm. long. P_5 is 10 mm. long. P_6 and P_7 are 10.5 mm. long.

P_8 and P_9 are 11 mm. long. All these pinnules have 14 or 15 segments. The pinnules following increase in length to about P_{17}, which is 16 mm. long with 22 segments which at first are short and, slowly increasing in length, become about as long as broad on the tenth and twice as long as broad terminally. There are about nineteen pairs of these long pinnules, after which the pinnules decrease in length and very slightly in stoutness. A distal pinnule (the twelfth from the arm tip) is 11 mm. long with 18 segments of which the first is more than twice as broad as long, the second is nearly half again as broad as long, the third is slightly longer than broad, and those following slowly increase in length becoming twice as long as broad distally, the terminal five tapering abruptly so that the last is minute.

A smaller and perhaps more typical specimen from Port Stephens (U. S. N. M., 35481) with 17 arms 50 mm. long and the cirri 30 mm. long differs in having the cirri apparently irregularly arranged on the centrodorsal, although there are indications of 20 columns; in having the cirrus segments more uniform in size, none of them longer than broad; and in having the pinnule segments shorter.

Notes.—Speaking of the 147 specimens collected by the *Endeavour* (1) 11 miles east-southeast of the Clarence River, (2) 8 miles east of Sandon Bluffs, (3) 6 miles east of Cape Hawke, (4) between Port Stephens and Newcastle, (5) in Shoalhaven Bight, and (6) on the southeast coast of Australia, Dr. H. L. Clark said that these show no tendency to intergrade with *P. macronema*, fully justifying my separation of the two forms.

Six specimens from east-southeast of Clarence River that I examined at the Museum of Comparative Zoology (No. 716) have 12, 13 (3), 15 and 20 arms; the three with 13 arms are small. Six specimens from between Port Stephens and Newcastle (No. 715) have 14, 16, 18, 19 (2), and 21 arms.

The two specimens from Broughton Island are both small.

Speaking of the 55 specimens from *Thetis* stations 10, 12, 28, and ?, Dr. H. L. Clark said that the smallest has the 10 arms only 16 mm. long, but nevertheless shows the adult specific characters fairly well; the centrodorsal is markedly conical, the X cirri have each about 40 segments, and the pinnules are decidedly prismatic. In the largest specimen there are 18 arms 60 mm. long, and the cirri have over 70 segments. The color of all the specimens (in alcohol) is brown, but the shade varies considerably, some individuals being decidedly purplish while others are yellowish, or more rarely somewhat reddish.

A specimen from *Thetis* station 10 in the Museum of Comparative Zoology (No. 374) has 14 arms; three from *Thetis* station 12 (No. 373) have 11 and 13 (2) arms.

The specimen from off Port Halliday is small with 10 arms 20 mm. long and the cirri about XV, 47–49, 17 mm. long. The smaller cirri are of an undeveloped type but the longer have distally taken on the characters of those of the adult. The cirrus sockets are arranged in two columns in each radial area with a more or less marked midradial space between them as in *Pterometra* and in many of the Thalassometridae.

The four specimens from Cape Hawke are of medium size with 12, 14, 17 and 18 arms. The largest has the arms 50 mm. and the cirri 40 mm. long.

The specimen from off Barranjoey is medium sized, stout, with 18 arms.

The eight specimens from Port Stephens in the British Museum recorded by Prof. F. Jeffrey Bell are fine typical examples of the species.

Of the 84 specimens from Port Stephens in the Australian Museum collection one, of moderate size, has 19 arms 55 mm. long and the longest cirri 50 mm. long with 94 segments. The others are of medium size with 15–20 arms.

The three specimens from Nelsons Bay, Port Stephens, are of medium size.

The six specimens from Newcastle Bight are medium sized.

The specimen from Newcastle in 77–88 meters has 19 arms 65 mm. long, two IIBr series are lacking and there is a single externally developed IIIBr series.

The single specimen from Broken Bay is of medium size.

Among the 11 specimens from Port Jackson in the Australian Museum one fine, large example has 19 arms 75 mm. long and the cirri about L, 84–90, from 60 to 65 mm. long, the centrodorsal is 4 mm. high and 6 mm. broad. Another large specimen has 23 arms 70 mm. long and the cirri 50–55 mm. long. The smallest has 12 arms 30 mm. long.

One very curious individual in the Australian Museum from Port Jackson has 23 arms about 65 mm. long, all the IIBr series and 3 IIIBr series being developed. The arms resemble those of ordinary specimens from the same locality, but the cirri are most extraordinary. There are about L cirri; at the base they resemble normal cirri, but most of them taper rapidly to a fine point, being only about 7 or 8 mm. long; they appear as if they had all been simultaneously broken off at the base and regenerated, though they are thicker at the base than regenerated cirri, a few, which are broken distally, are rather longer than the majority, though much smaller than normal; the longest stump is 15 mm. long. The color is a uniform slightly pinkish white.

The eight specimens from Port Jackson in the Museum of Comparative Zoology (No. 298) have 11, 12, 13, 14, 15, 16, and 17 arms. One has both arms and cirri 45 long. All are essentially similar.

One large specimen from Port Jackson in the U. S. National Museum has 23 arms. The others are smaller with 12, 14, and 18 arms.

Carpenter's description of *Antedon macronema* was based upon specimens of this species from Port Jackson. He said that the centrodorsal varies considerably in its shape. Most commonly it is a thick disk with a smooth dorsal surface and the cirrus sockets arranged irregularly on its sides, but it is sometimes more nearly hemispherical, and sometimes almost columnar with the sockets disposed in vertical rows (columns) of three or four each.

The cirri are very slender and reach 45 mm. in length, the longest having nearly 100 segments most of which are broader than long, the middle and distal segments are laterally compressed so as to overlap dorsally, and gradually develop a small spine.

The ends of the basal rays are often visible above the angles of the centrodorsal. The radials are nearly oblong. The IBr_1 are rather longer and more convex in the center; the lower ends are united, but the outer ends are free with sharp lateral edges. The IBr_2 (axillaries) are pentagonal, also much rounded in the center, with sharp straight edges and small flattened sides. The postradial series may divide twice. The IIBr series are 2. The elements of the IIBr series and lower brachials are rounded like the elements of the IBr series, with similar straight edges and small, flattened, outer sides. The inner side of the first syzygial pair (composed of brachials 3+4) may also show traces of flattening.

Arms 11–15 in number, about 65 mm. long, consisting of about 70 shortly triangular brachials, the lower ones rounded; the later brachials gradually become compressed laterally and develop a forward-projecting spine which overlaps the base of the next segment and is much more distinct in some individuals than in others.

The first syzygy is between brachials 3+4 and the next is between the eleventh and twenty-first brachials. The distal intersyzygial interval is from 4 to 9 (usually 5 or 6) muscular articulations.

P_1 and P_a are short and stiff, not more than 5 mm. long, and consist of 8 or 9 elongated segments. P_2 and P_b are much stouter, reaching 10 mm. in length, with about 12 rounded segments. The pinnules following are of about the same length with broader and more flattened basal segments which are sometimes slightly carinate. There are 6 or 8 pinnules of this character on either side of the arm, but the greater width of the lowest segments is distinct for some distance farther, and the length of the pinnules does not increase.

The disk, which is 7 mm. in diameter, is scarcely at all plated, and the brachial ambulacra are but slightly plated. The genital glands, contained in the expanded portions of the large lower pinnules, are protected by an imperfect pavement of ill-defined plates that supports the ambulacral skeleton. This last is not well differentiated; the covering plates are tolerably distinct, resting on a continuous calcareous band which is scarcely segmented into side plates except on some of the later pinnules. The position of the side plates, however, is indicated by the sacculi, which are also abundant on the brachial ambulacra and extend down on to the outer part of the disk.

In alcohol the calyx is nearly white and the arms a darkish purple.

Dr. Clemens Hartlaub noted that in a specimen from Sydney in the Göttingen Museum the position of the first syzygy varies from between brachials 3+4 to between brachials 4+5 or even 6+7.

The specimen from Port Phillip in the British Museum is a beautiful example.

Two of the specimens from the "Pacific Ocean" (presumably Sydney) collected by the United States Exploring Expedition in the National Museum have 14 and 20 arms; the one in the Museum of Comparative Zoology at Cambridge, Mass., has 15 arms 60 mm. long and the cirri 50 mm. long.

Dr. Wilhelm Minckert noted that in a fully grown individual, for which he gave no locality, he found one postradial series with small ossicles regenerating from a radial. The other four postradial series were normal.

Localities.—Eleven miles eastsoutheast of the Clarence river mouth, New South Wales; 64–66 meters; *Endeavour*, 1909–'14 [H. L. Clark, 1916] (6, M. C. Z., 716).

Eight miles east of Sandon Bluffs, New South Wales; 64–73 meters; *Endeavour*, 1909–'14 [H. L. Clark, 1916] (19, M. C. Z., 726).

Broughton Island [A. H. Clark, 1911] (2, U.S.N.M., 35502; Australian Mus.).

Thetis station 28; off Manning river; 40 meters; fine gray sand; February–March 1898 [H. L. Clark, 1909; A. H. Clark, 1911] (49, U.S.N.M., 35569; Australian Mus.).

Thetis station 12; off Cape Three Points; 40–62 meters; sand; February–March 1898 [H. L. Clark, 1909; A. H. Clark, 1911] (14, M. C. Z., 373, 375; Australian Mus.).

Off Port Halliday [A. H. Clark, 1911] (1, Australian Mus.).

Off Cape Hawke; 48–51 meters [A. H. Clark, 1911] (4, U.S.N.M., 36162; Australian Mus.).

Six miles east of Cape Hawke; 86–91 meters; *Endeavour*, 1909–'14 [H. L. Clark, 1916].

Off Barranjoey [A. H. Clark, 1911] (1, Australian Mus.).

Port Stephens; 11–15 meters (Bell, 1885; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (4, B. M.).

Port Stephens; 11–15 meters (3, U.S.N.M., 35503, 35536).

Port Stephens [Bell, 1885; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (4, B. M.).

Port Stephens [A. H. Clark, 1911] (84, U.S.N.M., 35476–35499, 35504–35510, 35526, 35527, 35529–35533, 35537; Australian Mus.).

Nelsons Bay, Port Stephens [A. H. Clark, 1911] (3, Australian Mus.).

Between Port Stephens and Newcastle; 40–110 meters; *Endeavour*, 1909–'14 [H. L. Clark, 1916] (6, M. C. Z., 715).

Newcastle Bight [A. H. Clark, 1911] (6, U.S.N.M., 36155; Australian Mus.).

Newcastle; 77–88 meters (1, U.S.N.M., 35501).

Hunter River, Newcastle [Wilton, 1843; Playdell (=Wilton), 1845; P. H. Carpenter, 1884; A. H. Clark, 1911; Etheridge, 1911].

Thetis station 10; off Broken Head; 51 meters; fine sand; February–March 1898 [H. L. Clark, 1909; A. H. Clark, 1911] (4, M. C. Z., 374; Australian Mus.).

Broken Bay [A. H. Clark, 1911] (1, Australian Mus.).

Port Jackson [A. H. Clark, 1911] (11, Australian Mus.).

Port Jackson (1, U.S.N.M., 17863).

Port Jackson; 11–18 meters (8, M. C. Z., 298).

Port Jackson; *Challenger;* 1874 [P. H. Carpenter, 1877, 1879, 1880, 1888; MacMunn, 1890; A. H. Clark, 1911, 1913] (4, U.S.N.M., 17527; M. C. Z., 299; B. M.).

Sydney Harbor (=Port Jackson; *Challenger*) [P. H. Carpenter, 1880].

Near Sow and Pigs Reef, Port Jackson [Whitelegge, 1889; A. H. Clark, 1911].

Sydney; W. H. Harvey [Wright, 1877; P. H. Carpenter, 1888; A. H. Clark, 1911].

Sydney [Hartlaub, 1891; A. H. Clark, 1911].

Shoalhaven Bight; 27–82 meters; *Endeavour*, 1909–'14 [H. L. Clark, 1916].

Port Phillip, Victoria; J. Bracebridge Wilson [P. H. Carpenter, 1890; A. H. Clark, 1911, 1913] (1, B. M.).

Southeastern coast of Australia; *Endeavour*, 1909–'14 [H. L. Clark, 1916].

Thetis station?; southeastern Australia [H. L. Clark, 1909] (11, Australian Mus.).

Australia [A. H. Clark, 1911] (1, Australian Mus.).

?Australia (fragments, M. C. Z., 63).

Pacific Ocean; U. S. Exploring Expedition (5, U.S.N.M., 2710–2714).

No locality; U. S. Exploring Expedition (1, M.C.Z., 62 [2704]).

No locality [Minckert, 1905].

No locality [A. H. Clark, 1911] (12, U.S.N.M., 35500, 35535; Australian Mus.).

No locality [A. H. Clark, 1913] (2, B. M.).

Geographical range.—From off the Clarence River in northeastern New South Wales southward and westward to Port Phillip, Victoria.

Bathymetrical range.—From the shore line down to 86 (?110) meters.

History.—In 1843, the Rev. C. Pleydell N. Wilton, of Newcastle, New South Wales, published the following account of a "new species of encrinite" that he called *Encrinus Australis:*

> The *Encrinus Australis* has no vertebral column, but its body, which is about ⅕ of an inch, is terminated in that direction by a circular base; the circumference of the body being indented by three rows of irregularly shaped hollow sections, each furnished with a circular orifice, to which the several tentacula of about 80 joints, and curving inwards towards their extremities, are appended, and by which the animal attaches itself to the sea-weed, which adheres to the bottom of the water-hole in the rock. To the opposite extremity of its body, which is always uppermost in the water, are attached five clavicles. Upon removing these from the body, its inferior surface presents a star of five points, each point being set in the angle formed by the two approaching segments of a circle, on which each of the clavicles reposed. Within this star is another star, also of five points. To each of these clavicles are attached two scapulae, into each of which the first two bones of the animal are inserted. On each of these is another scapula, from which proceed two arms. To two opposite sides of every alternate articulation of these arms, which gradually diminish in size to the extremity, are attached fingers, gradually tapering to a point, formed of several joints, which appear to vary in number according to the size and age of the specimen. In one of these I have counted twenty. Each of the joints of the arms is of a circular figure, with an oval orifice in the centre, from which proceed radii to the circumference. With its fingers, which the animal can either extend or contract at pleasure, either in a lateral or perpendicular direction, and which all curve outwards, the *Encrinus Australis* presents an appearance under the water of that species of lily called the Turk's cap, and of a beautiful lilac colour.

In 1845 the journal "L'Institut" published the following résumé of this article:

> Une espèce nouvelle d'Encrine vivante a été decouverte par le révérend C. Pleydell à Newcastle sur la rivière Hunter, dans la Nouvelle Hollande; l'auteur propose de lui donner le nom d'*Encrinus australis*. Elle n'a pas de colonne vertébrale, mais le corps de l'animal a environ un cinquième de pouce de long, et est terminé dans cette direction par une base circulaire. A l'extrémité oppose du corps sont attaché cinq appendices claviculaire, etc. M. Pleydell a essayé souvent de recueillir avec beaucoup de soin des échantillons complète de cet animal pour les envoyer en Europe; mais, après sa mort, les articulations ne tardent pas a s'en disjoindre et à tomber en pieces. La découverte de M. Pleydell est d'autant plus interressant que jusqu'à present on n'a encore rencontre que très rarement des échantillons un peu complets d'Encrines vivants, et encore le nombre des espèces en est-il très limité. On sait d'autre part combien sont nombreux ces animaux a l'état fossile dans presque la série des terrains stratifies, jusque peût-être dans les terrains tertiare, si l'on ajoute foi aux dernières decouvertes faites a ce sujet dans les terrains subapennins.

The original description was completely overlooked. There was no clue to its location in the résumé in "L'Institut," and the erroneous citation of the author's name made it difficult to trace. Dr. P. H. Carpenter called attention to the résumé in 1884, with the annotation "Is this a crinoid at all?" I again called attention to it in 1911 saying "This organism could not have been a Crinoid; what it was has remained, so far as literature is concerned, a mystery."

My notice came under the eye of Dr. Robert Etheridge, Jr., the Director of the Australian Museum at Sydney. He wrote that—

> Whilst reading the proofs of this Memoir, I felt convinced I had, in previous years, somewhere seen another reference to this "Encrinite," but could not, for the time being, remember where. By pure accident, on looking through some old memoranda, I came upon the original reference. The clergyman referred to was the Rev. "C. Pleydell N. Wilton," of Newcastle, and his paper, under the title of—"*On a New Species of Encrinite* (Encrinus Australis)," and of which the notice in "L'Institut"

is clearly an extract, was published in the "Tasmanian Journal of Natural Science," 1843, ii, No. vii, pp. 118–120.

It is quite evident from the tenor of his paper Mr. Wilton had many specimens. They were only found on the beach or in rock-pools, adhering to sea-weed, after gales. Examples of this organism were sent to Oxford previous to 1841, and presented to the Ashmolean Society.

After reading the original account, as given above, Dr. F. A. Bather of the British Museum (Natural History) wrote me that *Encrinus australis* was certainly a crinoid. On reading it myself I came to the same conclusion. The "body" is the more or less columnar centrodorsal; the "three rows of irregularly shaped hollow sections" are the cirrus sockets; the "tentacula of about 80 joints" are the cirri; the "five clavicles" are the radials; the "two scapulae" are the two elements of the IBr series; and the "fingers" are the pinnules. The joints in the arms "with an oval orifice in the centre from which proceed radii to the circumference" are the syzygies. The large number of cirrus segments, 80, and the color, show that this description can refer only to the species that has long been known as *Ptilometra mülleri* A. H. Clark, which now becomes *Ptilometra australis* (Wilton).

Wishing to see some of the Rev. Mr. Wilton's specimens if possible, I wrote to my friend Sir Edward B. Poulton at Oxford who was so very kind as to search the collection of the Ashmolean Muesum for me, but was unable to find them.

In 1877 Prof. Edward Perceval Wright described a new genus and species of sponge, *Kallispongia archeri*, that had been brought from Australia by W. H. Harvey, who found the specimens growing on *Delesseria*. In recording this paper in the Zoological Record for 1877 Stuart O. Ridley called attention to its crinoidlike form and said it was doubtful whether it was a sponge. Professor Wright's figures show what appear to be pentacrinoids of two species, presumably of this species and of *Compsometra lovéni*, both of which are common at Sydney. He distinguished the pentacrinoid of what is possibly this species as a variety.

In his preliminary report upon the comtulids collected by the *Challenger* published on March 6, 1879, Dr. P. H. Carpenter listed *Antedon macrocnema* (dredged at Port Jackson in 30–35 fathoms) as one of the seven species he had been able to identify with any certainty. In a memoir on the genus *Actinometra* published in 1879 Carpenter listed *Antedon macrocnema* (including both this species and *macronema*) as an *Antedon*, in contrast to *Actinometra* (=the family Comasteridae). In 1880 he wrote that the obsolescence of the boundary between the ligament and muscular fossae, the reduction of the latter, and the relative lowness of the articular faces characteristic of the Comasteridae reappears in *Antedon macrocnema*, almost alone in this respect among the species of *Antedon*. He also compared the centrodorsal and radial faces of *Antedon macrocnema* in detail with those of various fossil species. As the specimens used for dissection had been collected by the *Challenger* at Sydney (Port Jackson) the species concerned was *Ptilometra australis* and not *P. macronema*.

In 1882 Prof. F. Jeffrey Bell proposed a specific formula for *Antedon macronema* which was amended by Carpenter early in the year following.

In the *Challenger* report on the stalked crinoids published in 1884 Carpenter reprinted part of the summary of the account of *Encrinus australis* originally published in 1845.

In a paper published in 1885 on a collection of echinoderms that had been brought to London by E. P. Ramsay in connection with the Great International Fisheries Exhibition held in 1883 Professor Bell listed *Antedon mauonema* from Port Stephens.

In the *Challenger* report on the comatulids published in 1888 Carpenter discussed *Antedon macronema* at great length. The specimens described and those which he dissected were all collected by the *Challenger* at Port Jackson in 30–35 fathoms and therefore represented *australis*. He cited Bell's record from Port Stephens, which also refers to *australis*. The additional locality given by him, King Georges Sound, was taken from the type specimens of *macronema* in the Paris Museum.

In 1889 Thomas Whitelegge recorded specimens of *Antedon macronema* that had been dredged near Sow and Pigs Reef, Port Jackson, and Dr. C. A. MacMunn described the pigment from specimens collected by the *Challenger* in Port Jackson.

In the summer of 1887–88 a number of crinoids were dredged in the outer stations of Port Phillip, Victoria, and from outside the heads, all of them by J. Bracebridge Wilson. Twenty-nine specimens were forwarded to Dr. P. H. Carpenter, who, in 1890, listed two of them as *Antedon macronema*. I have examined both of these in the British Museum and found them to be specimens of *Ptilometra macronema*. But another fine specimen from the same locality, apparently unrecorded, is *Pt. australis*. Carpenter wrote, "I wish very much that you could get me some larvae of *Antedon macronema*. I want very much to study the development of the calyx, which is very Jurassic in its general characters."

In 1891 Dr. Clemens Hartlaub recorded a specimen of *Antedon macronema* from Sydney in the Gottingen Museum with an irregular distribution of the first brachial syzygy.

In 1894 Professor Bell compared *Antedon macronema* with his new *Antedon vicaria* (=*Mariametra vicaria*, see Part 4a, p. 573), and called attention to Hartlaub's note on the distribution of the first brachial syzygy.

Dr. Wilhelm Minckert in 1905 described a case of regeneration of a postradial series in *Antedon macronema;* his specimen undoubtedly represented *Ptilometra australis*.

In 1907 I listed *Ptilometra macronema* (J. Müller) in my new genus *Ptilometra*. In 1908 I compared *Ptilometra macronema* (=*australis*) with a new species described under the name of *Ptilometra* (*Pterometra*) *trichopoda*. In 1909 I described the new species *Ptilometra dorcadis* from Dirk Hartog Island, comparing it in detail with *P. macronema* (=*australis*). I wrote that "The type of *P. macronema* was taken at King George's Haven, in southwest Australia, while all the very numerous specimens I have examined are from the eastern coast, mostly from Port Jackson or Sydney; there is a possibility that the present species [*dorcadis*] will turn out to be the true *macronema*, in which case the form from Sydney would require a new name and might appropriately be known as *Ptilometra mülleri*." In my report on the crinoids of the *Gazelle* Expedition published later in 1909 I recorded *Ptilometra dorcadis* and quoted Professor Studer's notes on its occurrence and color.

Dr. Hubert Lyman Clark in 1909 recorded and gave notes on 55 specimens of *Ptilometra macronema* that had been dredged by H. M. C. S. *Thetis* off southeastern Australia. At the same time he described a new species that he called *Himerometra paedophora*.

In 1910 I suggested that the slight development of side- and covering-plates on the pinnules of *Ptilometra macronema* (=*australis*) might be explained by its feeding on living organisms which would instantly back away on coming into contact with these plates; for deep water species supposedly feeding largely on falling organic material, including dead organisms, such plates would be most useful in increasing the area of the pinnule and therefore its capacity for gathering food. In the summer of 1910 I visited Paris and there examined the type specimens of Müller's *Comatula macronema.* I found, as I had suspected, that these represented the species I had called *Ptilometra dorcadis,* so I used the name *Ptilometra mülleri* for the species living on the coast of New South Wales. I figured a cirrus of a specimen of *Ptilometra mülleri* from Sydney and another of a specimen of *P. macronema* from Kangaroo Island, both from specimens in the United States National Museum. My paper on the recent crinoids of the Paris Museum was published in 1911. In a paper on the crinoids of the Hamburg Southwest-Australian Expedition, 1905, published in 1911, I gave the range of *Ptilometra mülleri* as from Broughton Island to Port Phillip, and of *Ptilometra macronema* as from Port Phillip to Dirk Hartog Island. In a memoir on the recent crinoids of Australia published in 1911 I recorded and gave notes on 16 lots of specimens of *Ptilometra mülleri,* two of which were without definite locality, and discussed the species in detail. I noted that one of the figures given by Wright illustrating *Kallispongia archeri,* supposed by him to be a new sponge, probably represents this form, but as the figure is said to represent a varietal form no nomenclatorial confusion can result. I said that in 1888 Professor Bell described his *Antedon wilsoni* (=*Aporometra wilsoni*) from Port Phillip which, so far as I can see, is nothing but the young of the present species, though it was adopted as valid two years later by Carpenter. I added that more recently Dr. H. L. Clark has again described the young of this species, this time under the name of *Himerometra paedophora* (=*Aporometra paedophora*). I remarked that the specimens upon which Dr. Clark founded his *Himerometra paedophora* are obviously young, representing a stage just subsequent to the first appearance of P_2. The cirri are only just beginning to become carinate toward the tip, and the distal segments are as yet comparatively long. The sacculi are "abundant and large, especially in distal pinnules," as in the adult, and the disk already "shows many small calcareous plates, largest and most conspicuous around the base of the anal tube." Side and covering plates have not as yet made their appearance. I said that a specimen from Port Phillip, Victoria, is certainly referable to "*Antedon wilsoni,*" and "*Himerometra paedophora,*" and no less certainly to either *Ptilometra mülleri* or *P. macronema,* but which of the two it is impossible to say with accuracy. I gave a long and detailed account of *Himerometra paedophora.* In the introduction I gave the account of *Encrinus australis* published in "L'Institut" in 1845, and Dr. Robert Etheridge, Jr., reprinted the original account, published in 1843, as an appendix. In my memoir on the crinoids of the Indian Ocean published in 1912 I gave the synonymy and range of *Ptilometra mülleri,* and in my paper on the crinoids of the British Museum published in 1913 I recorded and gave notes on five lots including 13 specimens, four from Port Jackson (*Challenger*), Port Stephens, and Port Phillip, and one without locality.

In 1914 Prof. Frank Wigglesworth Clarke and W. C. Wheeler published a detailed analysis of the inorganic constitutents of the skeleton of this species based on a specimen from Sydney.

In 1915 I discussed the range of this species in my memoir on Antarctic crinoids, and also on a paper on the distribution of the crinoids of Australia.

In 1916 Dr. Hubert Lyman Clark recorded six lots including 145 specimens from the New Wouth Wales coast. He said that this series shows no tendency to intergrade with *P. macronema* and fully justifies my separation of the two forms. He remarked that none of the material in the collection throws any light on the disagreement between him and myself with reference to the young of *Ptilometra*. "We are each equally sure of being right, and no doubt will continue to feel so until the life history of one of the members of the genus is fully known. It seems to me possible that Bell's *Antedon wilsoni*, which I have never seen, and my *Himerometra paedophora* are the same species, but I am perfectly sure the latter is not a *Ptilometra* and has no near relationship to that genus. It is to be hoped that some Australian zoologist will before long investigate carefully the life history of the comatulids, so accessible from Sydney or from Melbourne."

Dr. Torsten Gislén in 1924 cited *Himerometra paedophora* as the young of *Ptilometra mülleri*, following me. He described various structural features of this species but did not give the origin of his material.

A further discussion of *Himerometra paedophora* and *Antedon wilsoni* will be found under the genus *Aporometra* (see Part 5).

Family ASTEROMETRIDAE Gislén

Basicurva group (in part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 102 (*Antedon longicirra* only); for further references see Part 4c; also Part 4a, p. 180.

Thalassometridae (in part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136; for further references see Part 4c.

Thalassometrinae (in part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 2; for further references see Part 4c.

Thalassomètres (in part) A. H. Clark, Bull. Mus. Hist. Nat., Paris, No. 4, 1911, p. 255.

Ptilometrinae (in part) A. H. Clark, Bull. Inst. Océanogr., Monaco, No. 294, 1914, pp. 7, 8 (*Asterometra* and *Pterometra*, but not *Ptilometra*); for further references see p. 393.

Thalassometriden (in part) A. H. Clark, Die Crinoiden der Antarktis, 1915, p. 192.

Asterometridae Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 118, 231 (new family; diagnosis), 236, 239; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 42. —Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, pp. 147, 148, 151.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 25.—A. H. Clark, Temminckia, vol. 1, 1936, p. 312; John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, p. 103.—Gislén, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 19.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 23 (in key), p. 56.

Diagnosis.—A family of the superfamily Tropiometrida in which the ventral perisome of the pinnules is protected by well developed side- and covering-plates; P_1 resembles P_2 but is shorter and more slender; and the centrodorsal is a short more or less pentagonal column with a conical tip with the radial areas separated from each other by more or less developed ridges and the cirrus sockets arranged in 10 definite columns, two in each radial area.

Geographical range.—From the Kei Islands and the Sahul Bank south of western Timor northwestward to the Gulf of Martaban and northward to the Philippines, the Bonin Islands, and southwestern Japan.

Bathymetrical range.—From 5 to 256 meters; most numerously represented between 50 and 200 meters.

Thermal range.—From 15.89° to 24.28° C.

Remarks.—The two genera included in this family are closely related, but on the basis of the somewhat scanty information available they appear to be distinct. In the characters of the centrodorsal and cirri *Pterometra magnipeda* and *Pt. pulcherrima* resemble the species of *Asterometra*, but in their other characters they are more closely related to the other species of *Pterometra.*

History.—The family Asterometridae was established by Prof. Torsten Gislén in 1924. In his superfamily Thalassometrida (= Tropiometrida) Professor Gislén recognized two subtribes, (a) Thalassometrida with no radial pits in the centrodorsal and the articular facets of the synarthries narrow and occupying only a part of the synarthrial face, including the families Thalassometridae, Charitometridae, and Calometridae; and (b) Notocrinida with deep radial pits and the articular facets occupying almost the whole of the synarthrial face. The Notocrinida he divided into two sections, (1) Notocrinida with the side- and covering-plates moderate, the brachials and pinnule segments rounded, and the genital glands in the arms, including the family Notocrinidae; and (2) Asterometridae, new family (including *Asterometra* and *Pterometra*), with the side- and covering-plates well developed, the brachials and pinnule segments prismatic-triangular, and the genital glands in the pinnules.

It seems to me that the family Notocrinidae in which all the pinnules, including the oral, are rounded, and the side- and covering-plates are rudimentary finds its logical position in the Macrophreata, and is quite out of place in the Tropiometrida. On the other hand, the species of Asterometridae in all their characters except the deep radial pits are in rather close agreement with the species of Thalassometridae, and in still closer agreement with the species of Ptilometridae with which I formerly united them in the subfamily Ptilometrinae of the family Thalassometridae. But as they form a very distinctive, though small, group there are certain advantages in following the lead of my friend Professor Gislén and recognizing them as representing a distinct family.

KEY TO THE GENERA OF THE FAMILY ASTEROMETRIDAE

a^1. Arms 20-30 in number; pinnules in the proximal third of the arms as long as, or even longer than, those in the distal half, composed of segments many or most of which are constricted centrally with produced and spinous distal ends; longer proximal cirrus segments usually more or less constricted centrally with prominent distal ends the ventral border of which usually overlaps more or less the base of the segments succeeding and may be produced into a long ventral spine (from the Kei Islands and eastern Java northwestward to the Gulf of Martaban and northward to Cochin China, the Philippines, and the Bonin Islands; 5–106 [?183] meters). **Pterometra** (p. 416).

a^2. Arms 10-16 (rarely over 13) in number; pinnules in the proximal third of the arm much shorter than those in the distal half, composed of segments which, except occasionally at the extreme tip, do not have overlapping and spinous distal ends; proximal cirrus segments with no central constriction or production of the distal edge (from the Kei Islands and the Sahul Bank westward to Bali and northward to the Bonin Islands and southwestern Japan; 73 [?72]=256 meters) ---------- **Asterometra** (p. 432.)

Genus PTEROMETRA A. H. Clark

Ptilometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 224.

Asterometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 546.

Pterometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 177 (diagnosis; genotype *Ptilometra trichopoda* A. H. Clark, 1908; referred to the Tropiometridae); Vid. Medd. Naturh.

Foren. København, 1909, p. 193 (probably occurs at Singapore); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (closely related to *Ptilometra* which represents it in Australia); Mem. Australian Mus., vol. 4, 1911, p. 725 (absent from Australia), p. 728 (referred to the Thalassometridae); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 10 (absent from Japan; reason), p. 11 (represented in the Ceylon region, its western limit), p. 24 (range; represents *Ptilometra*), p. 42 (referred to the Thalassometridae), p. 59 (in key), p. 189 (original reference; type); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 14 (in key; range), p. 143 (key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 99; Zool. Bidrag Uppsala, vol. 9, 1924, p. 231.—Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, pp. 151, 156.—Ekman, Tiergeographie des Meeres, 1935, p. 283.

Diagnosis.—A genus of Asterometridae in which the arms in fully developed individuals are 20–30 in number; the pinnules in the proximal third of the arm are as long as, or longer than, those in the distal half and are composed of segments many or most of which are constricted centrally with produced and spinous distal ends; the longer proximal cirrus segments are usually more or less constricted centrally with prominent distal ends which on the ventral side usually more or less overlap the bases of the segments succeeding and may be produced into a long spine.

Geographical range.—From the Kei Islands and eastern Java northwestward to the Gulf of Martaban and northward to Cochin China, the Philippines, and the Bonin Islands.

Bathymetrical range.—From 5 to 106 (?183) meters; most frequently reported between 50 and 100 meters.

Thermal range.—One record, 24.28° C.

Remarks.—The species of this genus are of very characteristic appearance. They are easily distinguished from the species of *Ptilometra* by the smaller centrodorsal on which the cirri are arranged in ten definite columns, and from the species of *Asterometra* by the greater number of arms and also by their color, the species of *Pterometra* being mostly red, purple, or brown, uniform or striped or blotched with light, whereas the species of *Asterometra* are usually clear light yellow. The specific limits recognized within the genus are to a certain extent tentative as few are known from a sufficient number of individuals to indicate adequately the range of variations.

History.—The first known species of this genus was described under the name of *Ptilometra trichopoda* in 1908. In 1909 this species was made the type of the new genus *Pterometra*. In 1911 *Asterometra magnipeda* was described, which was transferred to the genus *Pterometra* in 1918, since which time this genus has maintained the same status.

KEY TO THE SPECIES IN THE GENUS PTEROMETRA

*a*¹. No ventral spines on the longer proximal cirrus segments; no trace of carination on the division series; cirri numerous, XXX–XXXV; 20 arms.
  *b*¹. Cirri excessively long and stout, from one-fourth to one-third again as long as the arms; all 10 columns of cirrus sockets closely crowded against each other (Philippine Islands; 77 meters)..magnipeda (p. 426)
  *b*¹. Cirri shorter and more slender, usually from three-fourths to four-fifths of the arm length, rarely as long as or somewhat longer than the arms; columns of cirrus sockets separated by a narrow groove interradially and by a broader space in the midradial line (Kei and Damar Islands and eastern Java northward to the Gulf of Martaban and the southern Philippines; 36 [?30]—100 meters).. pulcherrima (p. 427)
*a*². Longer proximal cirrus segments bearing on the midventral portion of the distal edge a long sharp

spine that extends over the base of the following segment; cirri less numerous, usually XX-XXV; 20–30 (typically about 30) arms.

b^1. Proximal portion of the animal broad, the division series and arm bases as far as the seventh brachial at least as seen in lateral view diverging rapidly, at an angle of approximately 90°; color in alcohol uniform brown.

c^1. Cirri shorter and more slender, 50 mm. long with 86 segments; arms 80 mm. long (Philippines; 68 meters) ---------- **splendida** (p. 420)

c^2. Cirri longer and stouter, 75–77 mm. long with 99–113 segments (Cochin China to Celebes; 5–80 meters) ---------- **venusta** (p. 418)

b^2. Proximal portion of the animal very narrow, the division series and arm bases as seen in lateral view diverging very slowly, at an angle of about 45°; color in alcohol violet or purple, blotched and variegated with white (Bonin and Philippine Islands southward to the Kei Islands; 68–106 [?183] meters) ---------- **trichopoda** (p. 421)

PTEROMETRA VENUSTA A. H. Clark

PLATE 43, FIGURE 220

Pterometra venusta A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 424 (description; *Siboga* station 117); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 143 (in key; range; detailed description; station 117), p. 273 (listed), pl. 22, fig. 59.—GISLÉN, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 5 (French Indo-China), p. 6 (range), p. 19 (Pulo Condor; notes)

Diagnostic features.—The earlier cirrus segments have the ventral portion of the distal edge raised and overlapping the bases of the segments succeeding with the midventral portion produced into a long sharp spine; the division series and arm bases are evenly rounded dorsally and are broad, diverging regularly from the centrodorsal at an angle of about 90°; the cirri are XX–XXXIV, 99–113, 75–77 mm. long; the 22–28 arms are about 95 mm. long.

Description.—The centrodorsal is thick discoidal or columnar, the sides nearly parallel, 6 mm. broad at the base and 2.5 mm. high. The cirrus sockets are arranged in 10 equally spaced columns, each column separated from its neighbors on either side by a shallow groove from one-fourth to one-third of a cirrus socket in width. There are 2, more rarely 3, cirrus sockets to a column. The dorsal pole of the centrodorsal bears a rosette of five prominent tubercles.

The cirri are XX–XXV, 99–113 (usually nearer the latter), 77 mm. long, stout basally and tapering slightly distally, though this distal taper is more gradual than in *Pterometra trichopoda* and therefore not so marked. The longest cirrus segments are from one-third to one-half again as long as broad. In the earlier segments the ventral distal edge is rather prominent; after the eighth the median portion begins to project, overlapping the base of the next succeeding segment, this after the eleventh or twelfth becoming a sharp ventral spine which persists as far as the twentieth, or even the twenty-third, segment. At first this ventral spine makes a considerable angle with the longitudinal axis of the segments, but distally its outer part becomes more nearly parallel to it. The cirri are more broadly rounded ventrally than are those of *P. trichopoda*, and there is no well developed sharp ridge or keel extending back from the ventral spine along the midventral line of the segments. The dorsal processes arise very slowly, and are never very prominent. They first appear on about the twenty-third segment. The cirri are moderately compressed laterally, less so than in *P. trichopoda.*

The radials and division series resemble those of *P. splendida,* but the division series are slightly more robust.

The arms are 22–28 in number and resemble those of *P. splendida.*

In the type specimen (which has 28 arms) P_1 is 10 mm. long with 18 segments of which the terminal four or five are abruptly smaller than those preceding; it is considerably stouter and more sharply triangular than P_1 in *P. trichopoda.* P_2 is 11.5 mm. long with 16 segments, strongly though not sharply triangular in section, tapering evenly to a slender tip; the outer segments are about twice as long as broad, without projecting distal edges. P_3 is 15 or 16 mm. long with 16 segments of which those in the distal half are much elongated and slender, with prominent spines at the prismatic angles. P_4 is 17 mm. long with 15 segments similar to P_3 but with a slightly more even taper and hence appearing stouter distally. P_5 is 17 mm. long with 14 segments resembling P_4. P_6 is 16.5 mm. long with 14 segments resembling P_5. P_7 is 18.5 mm. long with 16 segments resembling P_6. P_8 is slightly stouter in the basal portion than the pinnules preceding. On the following pinnules the relative length of the stout basal portion increases so that the genital pinnules are broader and more sharply triangular than those preceding, with shorter segments of which only the outermost have spines at their prismatic angles. The distal pinnules are about 17 mm. long, becoming gradually shorter toward the arm tips.

Notes.—A specimen from *Siboga* station 117 with 22 arms about 95 mm. long is rather larger than the others, in all of which the arms are broken off at the base. P_1 is 9.5 mm. long with 14 segments. P_2 is 11 mm. long with 14 segments. P_3 is 15.5 mm. long with 17 segments. P_4 is 17 mm. long with 15 segments. P_6 is 18.5 mm. long with 17 segments. P_7 is 18.5 mm. long with 16 segments. P_8 is 19 mm. long with 19 segments. P_9 is 19.5 mm. long with 18 segments. P_{10} is 19 mm. long with 18 segments.

The specimen from Pulo Condor, according to Gislén, has the cirri XXXIV, 100–105, 75 mm. long. There are 27 arms, with the tips broken. There is a median tubercle on the radials. The synarthrial pairs have a broad and low synarthrial prominence, but there is no, or only a very indistinct, carination. The distal brachials are moderately carinate. The intersygial interval is 5 to 7 muscular articulations. The profile of the basal part of the animal is broad. The cirri are dark, brownish violet, the arms of a much lighter shade; the synarthrial prominences are white; the distal portions of the arms are indistinctly blotched with whitish.

Localities.—*Siboga* station 117; entrance to Kwandang Bay, Celebes (lat. 1°30′ N., long. 122°56′ E.); 80 meters; sand and coral; July 12, 1899 [A. H. Clark, 1912, 1918] (4, U.S.N.M., E. 423; Amsterdam Mus.).

Pulo Condor, Cochin China; 5 meters; Dr. C. Dawydoff [Gislén, 1936].

Geographical range.—From Cochin China to Celebes.

Bathymetrical range.—From 5 to 80 meters.

History.—This species was described in 1912 from a specimen from *Siboga* station 117. It was redescribed at greater length and figured in 1918, when notes were given on specimens other than the type.

Dr. Torsten Gislén in 1936 recorded and gave notes on a single specimen from Cochin China. He noted that it is similar to *P. trichopoda*, but the profile of the arm bases is broader, and there is not the high and characteristic carination of the division series.

PTEROMETRA SPLENDIDA (A. H. Clark)

Ptilometra splendida A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 33 (description; *Albatross* station 5179).

Pterometra splendida A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 190 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 143 (in key; range).

Diagnostic features.—The earlier cirrus segments have the ventral portion of the distal edge raised and overlapping the bases of the segments succeeding with the midventral portion produced into a long sharp spine; the radial ring and the ring formed by the IBr$_1$ are narrow and constricted, approximately cylindrical, appearing disproportionately small; beyond the IBr$_1$ the proximal portion of the animal is broad, the profiles of the division series and arm bases diverging at an angle of about 90°: the cirri are XXX, 86, 50 mm. long; the 30 arms are 80 mm. long.

Description.—The centrodorsal is columnar, 3 mm. in diameter at the base and 4 mm. high, with the center of the dorsal pole concave and surrounded by five broad low radially situated tubercles. The cirrus sockets are arranged in 10 evenly spaced columns, usually three to a column.

The cirri are XXX, 86, very long and slender and tapering slightly distally, 50 mm. in length. The first segment is short, the second is twice as broad as long, and those following gradually increase in length to the fifth or sixth, which is about as long as broad, and still further increase to the thirteenth or seventeenth, which is about half again as long as broad. After the nineteenth to twenty-sixth the segments decrease rather rapidly in length, soon becoming twice as broad as long, and even shorter teminally. The segments from about the seventh or eighth to about the twenty-fifth have the median portion of the distal ventral edge produced into a long slender curved overlapping spine, this reaching a maximum size on the tenth-thirteenth segments and then gradually dying away distally. As the ventral spines on the cirrus segments die away a slight prominence begins to appear on the dorsal distal edge in the median line which gradually becomes a prominent tubercle and encroaches more and more upon the dorsal surface of the segments distally becoming the broad high curved carinate dorsal spine characteristic of the outer segments of the cirri in all the species of this genus.

The ends of the basal rays are visible as small dorsoventrally elongate tubercles in the interradial angles of the calyx.

The basal portion of the animal has the appearance of being strongly constricted and disproportionately small. The radial ring and the ring formed by the IBr$_1$ are very narrow, 5 mm. in diameter; from this point the width of the animal, as seen in lateral view, increases rather rapidly to about the seventh brachial, where it reaches 20 mm.

The radials are short, of equal height all around the calyx, four or five times as broad as long, with a trace of a broad median tubercle. The IBr$_1$ are oblong, 4 times as broad as long, laterally united in the proximal half. The IBr$_2$ (axillaries) are very broadly pentagonal, two and one-half times as broad as long, with a slightly produced lateral border. Both the IBr$_1$ and the IBr$_2$ are faintly carinate. The IIBr series are 2. The IIIBr series are 2, developed exteriorly. The division series exteriorly have slightly produced ventrolateral edges.

The 30 arms are 80 mm. long, and resemble in general those of *P. trichopoda*, though they are somewhat more compressed and deeper proximally and sharply rounded instead of carinate distally.

The pinnules are essentially as in *P. trichopoda*, but are slightly stouter.

Locality.—*Albatross* station 5179; in the vicinity of Romblon; Romblon Light bearing S.56° E., 4.5 miles distant (lat. 12° 38′15″ N., long. 122°12′30″ E.), 68 meters; bottom temperature 24.28° C.; hard sand; March 25, 1908 (A. H. Clark, 1909, 1912, 1918) (1, U. S. N. M., 25517).

History.—This species is still known only from the single specimen collected by the *Albatross* in 1908.

PTEROMETRA TRICHOPODA (A. H. Clark)

[See vol. 1, pt. 1, fig. 46 (arm tip), p. 81; pt. 2, fig. 203 (lateral view), p. 137; fig. 208 (lateral view), p. 146; figs. 513, 514 (pinnule tip), p. 276; fig. 659 (articular face of a pinnular), p. 329.]

Ptilometra trichopoda A. H. Clark, Smithsonian Misc. Coll., vol. 52, part 2, 1908, p. 224 (description; *Albatross* station 5153; also station 5179); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 40 (comparison with *P. dorcadis*); Proc. U. S. Nat. Mus., vol. 37, 1909, p. 34 (compared with *P. splendida*).

Pterometra trichopoda A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 545 (*Albatross* stations 5356, 5413, 5414, 5593); Zool. Anz., vol. 39, No. 11/12, 1912, p. 424 (compared with *P. venusta*); Crinoids of the Indian Ocean, 1912, p. 190 (synonymy; range), fig. 32, p. 191; Die Crinoiden der Antarktis, 1915, p. 124 (shows characteristic features of *Anthometra adriani*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 143 (in key; range); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 14 (arm tip).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 5 (145–182 m.), p. 6 (Bonin Islands), p. 99 (Bock's stations 75, 48, 59; detailed notes), pp. 182, 183 (listed), figs. 101, 102, p. 122; Zool. Bidrag Uppsala, vol. 9, 1924, p. 44, fig. 287, p. 209, figs. 293, 294, 296, 298, p. 217.—Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, pp. 151, 156.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 25; Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 19 (relation to *P. venusta*).

Diagnostic features.—The earlier cirrus segments have the ventral portion of the distal edge raised and overlapping the bases of the segments succeeding with the midventral portion produced into a sharp spine; the proximal portion of the animal in constricted, the profiles of the division series and arm bases diverging from the centrodorsal at an angle of about 45°; the cirri are XV–XXII, 60–108 (usually 70–90), from 60 to 80 mm. long; the 20–30 arms are 60–75, rarely as much as 150 mm. long; the color is violet or purple striped and blotched with white.

Description.—The centrodorsal is columnar, the polar area a low truncated cone bearing five rather long rounded tubercles which are radial in position. The cirrus sockets are arranged in 10 columns, 2 columns in each radial area, with usually 2 cirrus sockets to a column.

The cirri are XX, 80–85 (usually 84 or 85), 60 mm. long, very long and slender, tapering gradually from a moderately stout base to a slender tip. The first segment is short, the second is about twice as broad as long, and those following gradually increase in length to the fifth, which is about as long as broad, and the eighth, which is not quite half again as long as broad. The segments succeeding as far as the eighteenth or twentieth are similar to the eighth, after which they gradually decrease in length, the thirty-second to the thirty-fifth being about as long as broad and those following gradually becoming broader than long, the terminal segments being very short. The segments from the fourth to about the sixteenth, though smooth dorsally, have a strong ventral overlap, and the middle of the distal ventral border is strongly produced in the form of a sharp and prominent spine this condition reaching a maximum on the eighth or ninth segment, then gradually decreasing in intensity and disappearing after about the sixteenth. At about the twenty-fifth segment a slight prominence of the distal dorsal edge is noticeable. After the thirty-sixth the median part of the dorsal edge is produced into a small sharp spine that projects distally in line with the rest of the dorsal surface of the segment. After about the fiftieth segment this spine begins to broaden basally, soon transforming into a high curved spine arising from the entire dorsal surface of the segments, just like the dorsal spines in the distal part of the cirri of *Ptilometra macronema.* The terminal four segments decrease rapidly in size. The opposing spine is very small, though of normal proportions when compared to the very small penultimate segment that bears it. The terminal claw is minute.

The ends of the basal rays are visible as dorsoventrally elongated tubercles in the angles of the calyx.

The radials are rather prominent, about four times as broad as long, with a rather low rounded tubercle in the median part of the proximal border. The IBr_1 are oblong, about three times as broad as long, in close lateral apposition and somewhat flattened laterally. The IBr_2 (axillaries) are rhombic, about twice as broad as long, with a tendency to rise into a low rounded tubercle at the articulation with the IBr_1. The IIBr and IIIBr series are 2, the latter developed exteriorly in 2, 1, 1, 2 order. The division series and first four or five brachials are sharply flattened laterally, but owing to the thinness of the ossicles dorsoventrally the flattened lateral border is comparatively narrow.

The 24–30 arms are 70 mm. long. The first eight brachials are discoidal or oblong, about twice as broad as long, the following gradually becoming more and more wedge-shaped and after the twelfth obliquely wedge-shaped, not quite so long as broad, and in the distal portion of the arms less obliquely wedge-shaped again, but not increasing in length. The arm ends abruptly with a few minute incurved segments as in *Ptilometra macronema,* the terminal pinnules exceeding the arm tip by about 4 mm. The arms in the proximal half are dorsally rounded and comparatively broad, becoming gradually strongly compressed and carinate distally, the brachials at the same time developing prominent overlapping spines as in *Ptilometra macronema.*

Syzygies occur between brachials 3+4, again from between brachials 13+14 to between brachials 19+20 (most commonly between brachials 17+18 with rarely an additional syzygy between brachials 7+8), and distally at intervals of from 6 to 12 (usually 7 or 8) muscular articulations. In one case the first syzygy is between brachials 6+7.

P_1 small and weak, about 6.5 mm. long with 10 to 12 segments of which the first is short, the second is rather longer than its distal width, decreasing in width distally, and the remainder are about two and a half times as long as broad. P_2 is about 9 mm. long, stiff and spinelike, with 15 segments of which the first is short, the second is rather longer than its distal width, the third is not quite so long as broad, and those following are about twice as long as broad. The pinnule is sharply triangular and the dorsal ridge on each segment is produced distally over the bases of the segments succeeding in the form of a slender spine. The third and following pinnules are similar to P_2, but about 10 mm. long. The pinnules as a whole are considerably more delicate than are those of *Ptilometra macronema.*

The plating of the disk and ambulacra is approximately as in *P. macronema.*

Notes.—In the specimen from Bock's station 45, according to Professor Gislén, the centrodorsal is 2 mm. broad at the base and 2 mm. high with 5 radially arranged warts on the dorsal pole. The cirri are arranged in 10 columns, 2 in each radial area, with 2 or 3 cirri in each column.

The cirri are XXIV, 67–75, the smaller number in those about the dorsal pole the larger in those nearest the radials, 38–44 mm. long. The earliest segments are short, the fourth is about as long as broad, those from the fifth to about the twentieth are half again as long as broad, and the succeeding are shorter again. The distal segments are twice as broad as long with a strong dorsal spine that rises to a height equal to between one-fourth and one-third the width of the segment from the thirtieth or fortieth segment onward. The fifth–twelfth segments have each a large ventral spine the length of which equals one-third the width of the segment on the distal edge which is curved and projects over a part of the segment following. The terminal claw is about as long as the penultimate segment.

The basals project upward in the interradial angles.

The radials are eight times as broad as long; they bear an abrupt mediodorsal tubercle. The IBr_1 are 4 times as broad as long, in apposition basally, with a mediodorsal crest. The IBr_2 (axillaries) are three times as broad as long with a similar crest on the proximal two-thirds. The IIBr series are 2. They, and the two first brachials, bear a crest similar to that on the IBr series.

The 20 arms are 60 mm. long. The first 9 brachials are discoidal, those following oblique. The distal brachials from about the fortieth onward have a slight dorsal spine as in the species of *Asterometra.*

Syzygies occur between brachials 3+4, 16+17, 23+24, 30+31, etc., on a sample arm.

P_1 is 4.5 mm. long with 11 segments. P_2 is 8 mm. long with 16 segments. P_3 is 8 mm. long with 11 segments. P_6 is 9 mm. long with 12 segments of which the first is twice as broad as long, the second is about as long as broad, and the third and following from half again to twice as long as broad, prismatic and smooth. The distal pinnules are 10 mm. long with 18 segments of which the outermost 6 are more delicate than the preceding and slightly collar-shaped.

In alcohol the arms and pinnules are white-gray, the cirri violet.

In a specimen from Bock's station 48 the 14 arms are 50 mm. long; the IIBr series are 2. The cirri are XV, 64–70, 35–44 mm. long. P_1 is 4.2 mm. long with 8 segments. P_2 is 5.2 mm. long with 10 segments. P_3 is 5.8 mm. long with 10 segments.

In a specimen from Bock's station 59 the cirri are XVI, 61–68, 30–35 mm. long. Dorsal spines are developed from the twenty-second to twenty-sixth segment onward; ventral spines occur from the fourth to the tenth (or twelfth, once) segments. The radials are 6 times as broad as long. The IBr_2 (axillary) is twice as broad as long. The 14 arms are all broken. P_1 is 3.5 mm. long with 7+ segments. The disk is 6.5 mm. in diameter and bears calcareous granules. This is a younger specimen than that first described and differs from it in the lower and dorsally smooth centrodorsal.

In another specimen from Bock's station 59 the centrodorsal is 3 mm. high, dorsally as in the specimen first described. The cirri are XXII, 66–84, 30–48 mm. long. The ventral spine is developed from the fourth to the thirteenth segments. The ossicles following the axillaries are basally in contact. The IBr_1 and $IIBr_1$ have the proximal border somewhat turned outward on either side of the median line. In the $IIBr_1$ this occurs only on the outer side. The IIBr series are 2. The 20 arms are all broken. The brachials bear blunt dorsal spines from about the fifteenth. The distal intersyzygial interval is 6–7 muscular articulations. P_1 is 5 mm. long with 10+ segments. The disk, which is detached, is 10 mm. in diameter.

In another specimen from Bock's station 59 the centrodorsal is 1.5 mm. high; the dorsal pole has 5 indistinct radial tubercles and a slight central prominence. The cirri are XV, 68–75, 32–37 mm. long; ventral spines occur on the four-tenth segments, and dorsal spines from the twentieth to twenty-fifth segment onward. The 17 arms are all broken. The IIBr series are 2. P_1 is 4 mm. long with nine segments. The disk is granulated and very much incised; its longest diameter is 6 mm., its shortest 3 mm. Gislén said that the proximal portion of these specimens is narrow, and the arms are strongly bent outward after the eighth brachial. They differ from the type specimen chiefly in having fewer arms and in being somewhat smaller.

Of the 16 specimens from *Albatross* station 5414 one has 30 arms 60 mm. long and the cirri 50 mm. long with 70–87 segments. Another has 20 arms 73 mm. long and the cirri 77 mm. long, the longest with 100 segments; the cirri of this specimen are rather stouter than those of the preceding. Another has 20 arms 60 mm. long and the cirri 60 mm. long. Another has 21 arms 65 mm. long and the longest cirrus 75 mm. long with 106 segments. Another has 19 arms. Another has 22 arms 75 mm. long, with the longest cirrus 80 mm. long. Another has 23 arms 65 mm. long and the cirri 70 mm. long. Another has 29 arms. Another has 20 arms; one IIBr series is lacking, but a IIIBr series is developed on one postradial series. Seven specimens have from 20 to 25 arms.

Of the two specimens from *Albatross* station 5413 one has 20 arms 75 mm. long and the cirri 80 mm. long, and the other has 21 arms 70 mm. long and the cirri 75 mm. long.

The specimen from *Albatross* station 5356 is small with 16 arms.

The specimen from *Albatross* station 5593 has 23 arms and the longest cirrus 80 mm. long with 108 segments.

In these *Albatross* specimens the cirri average about 5 mm. shorter than the arms, though they are often the same length and may even be longer. The IIIBr series, when developed, are always external, in 2,1,1,2 order.

The specimen from the Danish Expedition to the Kei Islands station 24 has 21 arms about 65 mm. long; the single IIIBr series is externally developed. The cirri have 64–79 segments and are 40–50 mm. long.

Localities.—Dr. Sixten Bock's station 45 ("75"); Bonin Islands, east of Chichijima; 146 meters; July 31, 1914 [Gislén, 1922, 1924, 1934, 1936; Sieverts, 1932].

Dr. Sixten Bock's station 59; Bonin Islands, eastnortheast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922, 1924, 1934, 1936; Sieverts, 1932].

Dr. Sixten Bock's station 48; Bonin Islands, east of Chichijima; 100 meters; August 1, 1914 [Gislén, 1922, 1924, 1934, 1936; Sieverts, 1932].

Albatross station 5444; off the east coast of Luzon; Atalaya Point, Batag Island bearing S. 65° E., 5.1 miles distant (lat. 12°43′51″ N., long. 124°58′50″ E.); 563 meters; bottom temperature 7.39° C.; green mud; June 3, 1939 (1, U. S. N. M., 35542).

Albatross station 5179; in the vicinity of Romblon; Romblon Light bearing S. 56° E., 4.5 miles distant (lat. 12°38′15″ N., long. 122°12′30″ E.); 68 meters; bottom temperature 24.28° C.; hard bottom; March 25, 1908 [A. H. Clark, 1908, 1909, 1912, 1915, 1918; Sieverts, 1932].

Albatross station 5414; between Cebu and Bohol; Lauis Point Light Bearing N. 67° W., 9.5 miles distant (lat. 10°10′40″ N., long. 124°02′45″ E.); March 24, 1909 [A. H. Clark, 1911] (13, U.S.N.M., 35538, 35540, 35543–35551, 35553, 35554).

Albatross station 5413; between Cebu and Bohol; Lauis Point Light bearing N. 68° W., 10 miles distant (lat. 10°10′35″ N., long. 124°03′15″ E.); 77 meters; coral and sand; March 24, 1909 [A. H. Clark, 1911] (2, U.S.N.M., 35539, 35555).

Albatross station 5356; North Balabac Strait; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″ E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35541).

Albatross station 5153; Tawi Tawi group, Sulu (Jolo) Archipelago; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5°18′10″ N., long. 120°02′55″ E.); 89 meters; coral sand and shells; February 19, 1908 [A. H. Clark, 1908, 1909, 1912, 1915, 1918; Sieverts, 1932] (1, U.S.N.M., 25447).

Albatross station 5593; Sibuko Bay, Borneo; Mt. Putri (sea tangent), Borneo, bearing N. 52° W., 17.2 miles distant (lat. 4°02′40″ N., long. 118°11′20″ E.); 69 meters; fine sand; Sept. 29, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35552).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 24; 100 meters; hard bottom; April 15, 1922 (1).

Note.—The record from *Albatross* station 5444 is very dubious. The specimen cataloged as from that station lacks the original label. It probably came from station 5179 from which station no specimen is cataloged, but from which I recorded the species in 1908. Station 5444 is disregarded in the following summary.

Geographical range.—From the Bonin and Philippine Islands southward to the Kei Islands.

Bathymetrical range.—From 68 to 106 (possibly 183) meters. Dr. Bock's records represent the length of line out, not the actual depth.

Thermal range.—One record, 24.28° C.

History.—This species was described in 1908 under the name of *Ptilometra trichopoda* from a specimen dredged by the *Albatross* at station 5153 in the Philippines earlier in the same year; at the same time it was recorded from station 5179. *Ptilometra trichopoda* was made the type of the new genus *Pterometra* in 1909.

In 1911 it was recorded from *Albatross* stations 5356 (1), 5413 (2), 5414 (16), and 5593 (1), and notes were given on some of the specimens.

In 1922 Prof. Torsten Gislén recorded and gave notes on specimens that had been collected by Dr. Sixten Bock in the Bonin Islands at stations 45 (1), 48 (1), and 59 (5). Professor Gislén discussed the structure and relationships of the species further in 1934 and 1936.

PTEROMETRA MAGNIPEDA (A. H. Clark)

Asterometra magnipeda A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 546 (description; *Albatross* stations 5413, 5414); Crinoids of the Indian Ocean, 1912, p. 193 (synonymy; locality).
Pterometra magnipeda A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 1943 (in key; range).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnostic features.—The earlier cirrus segments do not have overlapping distal ends; the cirri are XXV–XXX, 99–122, the longest 95–118 mm. long, exceedingly long and stout, from one-fourth to one-third again as long as the arms, seldom about as long as the arms; 20 arms 95–100 mm. long.

Description.—The centrodorsal is columnar, 6 mm. in diameter at the base and 5 mm. high, with the dorsal pole elevated into a high truncated conical process about 3 mm. high surmounted by a rosette of 5 small radially situated tubercles. The cirrus sockets are arranged in 10 columns of 3 each, the 2 columns in each radial area being interiorly separated by about twice the distance separating the columns of adjacent areas.

The cirri are XXX, 109–122, from 100 mm. to 118 mm. in length. The first segment is short, and the following gradually increase in length, becoming about as long as broad on the sixth. The succeeding segments are similar or slightly longer, rarely so much as half again as long as broad, in the distal third of the cirri very slowly becoming shorter, in the terminal portion being somewhat over twice as broad as long. Beyond the proximal half of the cirri the segments very slowly become carinate dorsally and develop a projecting distal dorsal edge which is centrally elevated into a small spine; this slowly increases in height, involving more and more of the dorsal surface of the segment until in the very short terminal segments a high carinate spine is found reaching nearly one-half the width of the segments in height, resembling the same structure found in the other species of the genus. The last few segments taper rapidly, as in related species. A more or less marked transition segment occurs between the sixteenth and twenty-second, usually between the eighteenth and twentieth. The ventral distal edge of the proximal segments is slightly everted.

The IBr series and the IIBr series, the latter 2, resemble those of *Asterometra macropoda*. The dorsal surface of the division series and lower brachials is evenly and broadly rounded.

The 20 arms are 90 mm. long, resembling those of *Asterometra macropoda*, though somewhat more slender basally.

P_1 is 8 mm. long, small, slender, and evenly tapering, stiff, with 16 segments. P_2 is 13 mm. long, stouter than P_1, with 17 segments of which the distal have produced and spinous distal ends. P_3 is 15 mm. long, slightly stouter than P_2, with 16 segments. P_4 is 16 mm. long, resembling P_3. P_5 is 14 mm. long. P_7 is 13 mm. long. The following pinnules are similar, becoming gradually more slender distally and increasing in length to 14 mm. The terminal 4 or 5 pinnule segments have no ambulacral structures and are abruptly smaller and more slender than those preceding, with very spinous distal ends.

Notes.—The specimen described above was from *Albatross* station 5413. Another specimen from the same station has 20 arms 90–95 mm. long and the cirri 100–110 mm. long with 99–105 segments; the longer cirri are broken at the tip.

Of the nine specimens from *Albatross* station 5414 one has 21 arms 95 mm.

long with the cirri XXV, 99–112, 90–105 mm. long; the single IIIBr series is developed externally. Another has 20 arms 100 mm. long and the cirri 95–105 mm. in length. Another has 20 arms 95 mm. long and the cirri 90–95 mm. long. Of the remaining specimens one (small) has 13 arms, one (small) has 16 arms, one has 18 arms, two have 19, and one has 20.

This species appears to be most nearly related to *P. pulcherrima* from which it differs in the much greater development of the cirri.

Localities.—*Albatross* station 5413; between Cebu and Bohol; Lauis Point Light bearing N. 68° W., 10 miles distant (lat. 10° 10′ 35″ N., long. 124°03′15″ E.); 77 meters; March 24, 1909 [A. H. Clark, 1911, 1912, 1918; Gislén, 1934] (3, U.S.N.M., 27495, 35785).

Albatross station 5414; between Cebu and Bohol; Lauis Point Light bearing N. 67° W., 9.5 miles distant (lat. 10°10°40″ N., long. 124°02′45″ E.); March 24, 1909 [A. H. Clark, 1911, 1912, 1918; Gislén, 1934] (9, U.S.N.M., 35852).

History.—This species was described under the name of *Asterometra magnipeda* in 1911 from a specimen from *Albatross* station 5413. At the same time two additional specimens were recorded from station 5413 and nine from station 5414 and notes on these were given. It was referred to the genus *Pterometra* in 1918. It was discussed by Dr. Torsten Gislén in 1934.

PTEROMETRA PULCHERRIMA (A. H. Clark)

Plate 43, Figures 218, 219

Ptilometra pulcherrima A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 40 (*nomen nudum;* relation to *P. trichopoda*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 400 (description; *Albatross* station 5252); vol. 39, 1911, p. 547, footnote (referred to *Asterometra*).

Asterometra pulcherrima A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 547 (most closely related to *A. magnipeda*); Crinoids of the Indian Ocean, 1912, p. 193 (synonymy; new locality; range).

Pterometra pulcherrima A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 143 (in key; range), p. 145 (synonymy; notes; station 144), p. 273 (listed), pl. 9 (colored figure), pl. 28, fig. 104; Treubia, vol. 14, livr. 2, 1933, p. 207 (listed), p. 214 (south of the eastern end of Java; notes).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.—A. H. Clark, Temminckia, vol. 1, 1936, p. 313 (*Snellius* station 60*; notes).

Diagnostic features.—The earlier cirrus segments do not have produced and overlapping distal ends; the cirri are XII–XXV (usually XVI–XX), 80–120 (usually 90–110), from 78 to 128 (usually 85–90) mm. long, usually from three-quarters to four-fifths of the arm length, rarely longer than the arms; arms 20, from 70 to 120 (usually 90–115) mm. long.

Description.—The centrodorsal is large, columnar, with the sides parallel, terminated by a group of five large tubercles each radial in position which arise from an otherwise flat polar area. A small circular space bounded by the ends of these tubercles is light in color, this light color extending in interradial lines between the summits of the tubercles and thence to the periphery of the polar area. The centrodorsal is 6 mm. in diameter at the base and 5 mm. long. The cirrus sockets are arranged in 10 columns of three or four each, the radial areas being separated from each other by low rounded ridges, and the pairs of columns in each radial area being separated by a broad shallow groove which is about twice as broad as the rounded interradial ridges.

The cirri are XXXV, 80–85 (the less developed as few as 68), long and slender, from 75 mm. to 80 mm. long. The first segment is short, the second is about twice as broad as long, and those following gradually increase in length to the sixth or seventh, which is about as long as broad. The following 15 to 20 segments are between one-third and one-half again as long as broad, those succeeding very slowly decreasing in length so that the distal 30 to 35 segments are about twice as broad as long. The cirri are somewhat laterally compressed distally. After the seventeenth to the twentieth segment the median part of the distal dorsal edge begins to project as a sharp and slender spine, which is directed diagonally forward. This spine gradually increases in length, at the same time arising from more and more of the dorsal surface of the segments, on the short distal segments arising from their entire dorsal surface. It has a slightly convex proximal and more strongly concave distal profile, and equals in height about one-half the width of the segments. The terminal 8 or 10 segments taper rather rapidly, at the same time increasing slightly in relative length, so that the antepenultimate and penultimate segments are very small and about as long as broad. The opposing spine is equal in length to the width of the penultimate segment, blunt, the distal profile forming a straight line with the distal edge of the penultimate segment, and arises from nearly or quite the entire dorsal surface of that segment. The terminal claw is slightly longer than the penultimate segment and is comparatively stout and strongly curved.

The disk is naked. All but one of the ambulacral grooves, which divides immediately, are given off in well separated pairs so that 9 ambulacral grooves reach the mouth. The brachial ambulacra are naked. The pinnule ambulacra have small, but well developed, side and covering plates.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are short, of approximately equal width all around the calyx, slightly convex proximally and correspondingly concave distally. The IBr_1 are oblong, three times as broad as long, in close apposition laterally, with an indicated broadly rounded median keel. The IBr_2 (axillaries) are broadly pentagonal, two and one-half times as broad as long, with the lateral edges about half as long as those of the IBr_1 and the sides sharply flattened against their neighbors. The IIBr series are 2, resembling the IBr series but proportionately slightly longer; they have the same indicated broadly rounded median keel, and are sharply flattened laterally and in close apposition.

The 20 arms are 100 mm. in length. The first 2 brachials are slightly wedge-shaped, about twice as broad as long, sharply flattened and in close apposition exteriorly, the first closely united interiorly, the second in close apposition and flattened interiorly. The first syzygial pair (composed of brachials $3+4$) is oblong, about one-third again as broad as long. The next four or five brachials are oblong, about three times as broad as long, those succeeding becoming wedge-shaped and after the twelfth or fifteenth triangular, two and one-half times as broad as long, and in the terminal part of the arm wedge-shaped again and slightly longer. The arm ends abruptly with six or seven very small and short brachials curving inward between the terminal pinnules, which extend for 4 mm. beyond the arm tips. The arms are broadly convex dorsally in their basal portion, with the first seven or eight brachials sharply flattened laterally, very gradually becoming narrower and distally strongly carinate. At about the twelfth or fifteenth brachial a broadly rounded median keel begins to be indicated; this gradually narrows distally and on the twentieth to the twenty-fifth brachial the median portion of the distal edge begins to be slightly prominent. These features increase slowly in extent, the median keel at the same time narrowing, so that the brachials in the outer half of the arms are bluntly carinate with the median portion of the distal edge produced, and in the terminal portion sharply carinate with prominent overlapping spines.

P_1 is 8 mm. long, strongly prismatic, slightly less stout than the succeeding pinnules, with 16 segments of which the first is short, the second and third are about as long as broad, and the remainder are very slightly longer than broad, becoming about one-third again as long as broad distally. P_2 is 12.5 mm. long with 19 segments of which the first is twice as broad as long, the second is about as long as broad, and the remainder are very slightly longer than broad. The more distal segments exhibit a tendency toward a slight production of their distal edges at the prismatic angles. The terminal 3 or 4 segments taper rather more rapidly than usual. P_3 is 14 mm. long with 17 segments of which the first is twice as broad as long, the second is about as long as broad, and those following very gradually become longer than broad and twice as long as broad in the terminal portion. The last six segments taper rather rapidly, and the last two are minute. From the fourth segment onward small spines are developed on the distal border of the segments and on the distal keel of the pinnule, and on the last 4 segments there is in addition a somewhat longer spine developed on the corresponding interior angles. P_4 is 15 mm. long with 16 segments, all but the basal of which are proportionately longer than those of P_3, the distal with long spines on their prismatic angles, P_5 is similar, slightly longer. P_8 is similar, 17 mm. long. P_{10} is 19 mm. long with 20 segments which become elongate distally and bear long spines at the prismatic angles. In the terminal portion of the arms the pinnules slowly decrease in length. The abrupt distal taper gives the pinnules the appearance of having been broken off and subsequently repaired.

Description of a specimen from Investigator *station 387.*—The centrodorsal is thick discoidal, about twice as broad at the base as high; the dorsal pole bears 5 irregular interradial tubercles. The cirrus sockets are arranged in 10 columns, 2 or 3 to a column. These columns are equidistant from each other and, though entirely free, are only very slightly separated.

The cirri are XXV, 72–88, from 46 mm. to 54 mm. in length. The first segment is short and those following gradually increase in length becoming about as long as broad on the ninth or tenth, about one-third again as long as broad on the fourteenth, and after the twenty-second or twenty-third gradually decreasing in length so that those in the distal fourth of the cirri are about three times as broad as long. From the fifth or sixth to about the twenty-third the segments bear very prominent, though not very long, overlapping ventral spines which are rather strongly curved on their ventral profile so that at the tip they are almost parallel with the longitudinal axis of the cirri. The short distal segments bear broad dorsal spines.

The ends of the basal rays are visible as very small triangular areas in the interradial angles of the calyx.

The radials are nearly as long as the IBr_1 in the median line, about 4 times as long as broad, with the proximal and distal borders approximately straight and parallel; they bear in the center a prominent and rather high blunt median ridge which in lateral view shows an evenly and strongly convex profile. The IBr_1 are about three times as broad as long in the midradial line or slightly broader, with the distal border gently concave. They bear a well-rounded medioposterior tubercle which is situated about one-third of the way between the proximal and distal borders. This tubercle rises very gradually both proximally and distally so that in a profile view its sides are seen to be nearly straight; in a direct dorsal view it appears as a rather broad median carination. The IBr_2 (axillaries) are about twice as broad as long with the lateral angles broadly truncated, the lateral borders being about two-thirds as long as those of the IBr_1. There are 3 very faintly indicated elevations on the dorsal surface in the form of low and obscure broadly rounded elongate tubercles which scarcely rise above the general surface One of these is situated just proximal to each distal face to which its longer axis stands at right angles, while the third, rarely to be made out at all, is situated in the median line in the proximal half of the ossicle. The lateral borders of the IBr_2 are swollen and everted, forming a narrow rounded lateral border which is continued for a greater or lesser distance proximally on to the IBr_1. The IIBr series are 2, resembling the IBr series, except that on the axillaries the medioposterior ridge is more prominent than the 2 anterior; the swollen border of the IBr_2 is continued out along the outer side of the $IIBr_1$ and disappears at the distal margin of the $IIBr_2$.

The 20 arms are about 70 mm. long. A faint well-rounded median ridge runs along the dorsal surface of the arm, gradually transforming into the distal carination.

P_1 is 7 mm. long with 15 segments. P_2 is 10 mm. long with 15 segments of which the distal are elongated with produced and spinous distal angles. P_3 is 11.5 mm. long with 14 segments, resembling P_2. P_4 is similar to P_3. P_5 is 10 mm. long, slightly stouter, with 13 segments. P_6 is 11 mm. long with 13 segments, resembling P_5. The distal pinnules are 12 mm. long.

Notes.—The specimen from *Willebrord Snellius* station 60* has 20 arms 90 mm. long. The cirri are 50–55 mm. long with 70–76 segments.

The specimen from Banda is a particularly fine example with 20 arms 115 mm. long. All the IIBr series are present. The cirri are XX, 109–113, up to 128 mm. in length. On the centrodorsal the columns of cirrus sockets, which consist of three, two, or one sockets, are separated interradially by a narrow line, and in the midradial line by a bare line about twice as broad, nearly as broad as a cirrus socket. The dorsal pole of the centrodorsal is almost flat with, in the center, a rosette of five low radially situated tubercles.

The specimens from the Danish Expedition to the Kei Islands station 24 present the following details. One has 20 arms 120 mm. long. On the centrodorsal the columns of cirrus sockets are in contact interradially but are separated by a narrow space in the midradial line. The cirri are XVI, 90–102, 117 mm. long. Another has 18 arms 90 mm. long, IIBr series being absent from one postradial series. On the centrodorsal the columns of cirrus sockets are separated by a narrow groove interradially and in the midradial line by a bare area about as broad as the sockets. The cirri are XVI, 71–87, 65–85 mm. long. One has 20 arms. The centrodorsal has the dorsal pole nearly flat bearing in the center a rosette of five conspicuous radially situated tubercles. The columns of cirrus sockets are separated interradially by a narrow sinuous groove and in the midradial line by a broad bare area. The cirri are XVII, 116–120. Two specimens have 20 arms. Two specimens have 12 arms; both of these are small. In one the arms are about 60 mm. long. There are two IIBr series on one postradial series. A very small specimen has 10 arms 30 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 26 consists of the centrodorsal, cirri, and basal portion of the division series. The cirri are XXV, 110–112, 90–120 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 53 is very small with 10 arms 30 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 54 has 12 arms measuring 115 mm. from the rim of the centrodorsal. The cirri are XII, 118–119, 112 mm. long. The radials have a median tubercle of which the maximum height is in the proximal half. The IBr_1 have a very faint and indistinct median elevation. The IBr_2 (axillaries) have a similar indistinct median elevation the highest points in which are near the proximal border and halfway between the distal angle and the proximal border. The elements of the IIBr series (which are 2) and the first two brachials have the dorsal surface unmodified. P_1 is 7.5 mm. long with 14 segments, scarcely tapering in the basal half but from that point on tapering gradually to the tip. The genital pinnules are 15 mm. long with 18 segments. Pinnules 20 mm. from the arm tip are 10 mm. long with 18–19 segments. In spite of the small number of arms this appears to be a specimen of this species.

The specimen from *Siboga* station 144 agrees well with the type from *Albatross* station 5252. There are 20 arms 90–95 mm. long. The cirri are XX, 92–96, 78 mm. long. The color in alcohol is white.

The specimen from south of the eastern end of Java is a fine typical example of the species. There are 18 arms 80–90 mm. long. The cirri are composed of 88–92 segments and are 60–75 mm. long. On one of the cirri the terminal claw has at the base on the dorsal side a process exactly resembling an opposing spine that rises to a height equal to about half the width of the base of the terminal claw.

Localities.—*Albatross* station 5252; Gulf of Dávao, Philippines; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7°04′48″ N., long. 125°39′38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909, 1911, 1912, 1918] (1, U.S.N.M., 25466).

Snellius station 60*; west of Zamboanga, Mindanao (lat. 6°58′00″ N., long. 121° 52′30″ E.); 72–80 meters; September 5, 1929 [A. H. Clark, 1936] (1, L. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; off Kombit, Banda; about 100 meters; sand; June 9, 1922 (1 U.S.N.M., E. 3224).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 24; 100 meters; hard bottom; April 15, 1922 (8, U.S.N.M., E. 3207; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 26; about 90 meters; sand; April 16, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 53; 85 meters; sand and coral; May 9, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 54 (1, C. M.).

Siboga station 144; anchorage north of Salomakiëe (Damar) Island, southern Moluccas; 45 meters; coral and lithothamnion; August 7–9, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

South of the eastern end of Java (lat. 8°47′ S., long. 114°38′ E.); 30–36 meters; November 10, 1908 [A. H. Clark, 1933] (1, Buitenzorg Mus.).

Investigator station 387; southwest of the mouths of the Irrawaddy River (lat. 15°25′ N., long. 93°45′ E.); 73–89 meters [A. H. Clark, 1912] (1, I. M.).

Geographical range.—From the southern Philippines and the Gulf of Martaban, Burma, southward to the Kei and Damar Islands and eastern Java.

Bathymetrical range.—From 36 (?30) to 100 meters.

History.—The name *P[tilometra] pulcherrima* first appeared as a *nomen nudum* in 1909. Speaking of *Ptilometra dorcadis*, new species, I wrote that "Its remarkably robust aspect differentiates it from *P. macronema* in about the same degree that that species is differentiated from *P. trichopoda* and *P. pulcherrima* of the Philippine Islands." In a paper written before the one just noticed though published later in 1909 *Ptilometra pulcherrima* was described in detail from a specimen from *Albatross* station 5252. In 1911 in the description of *Asterometra* (=*Pterometra*) *magnipeda* this species was said to be most nearly related to *Asterometra pulcherrima*, which was identified by a footnote reference to the original description of *Ptilometra pulcherrima*. In 1912 I recorded a specimen that had been dredged by the Royal Indian Marine Survey Steamer *Investigator* southwest of the mouths of the Irrawaddy River which was said to agree well with the type and with another in the *Siboga* collection. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 *pulcherrima* was referred to the genus *Pterometra*. A specimen was recorded from *Siboga* station 144 and notes on it were given. A colored figure and a photograph of the specimen were published.

In 1933 a specimen was recorded, with notes, from south of the eastern end of Java. Dr. Torsten Gislén in 1934 discussed various structural features of this species. In 1936 I recorded and gave notes on a specimen from *Willebrord Snellius* station 60*.

Genus ASTEROMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 103, and following authors.

Ptilometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359.

Asterometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 358 (genotype *Antedon macropoda* A. H. Clark, 1907); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (same); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (referred to the Tropiometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (same), p. 212 (occurs in Japan), p. 318; Amer. Nat., vol. 42, No. 500, 1908, p. 541 (only known from the Indo-Pacific-Japanese area); No. 503, p. 725 (color); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (characteristic of the Indo-Pacific-Japanese area); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (side and covering plates more or less imperfect), p. 642 (tip of the centrodorsal compared with that of [*Oceanometra*] *annandalei*); Vid. Medd. Naturh. Foren. København, 1909, p. 182 (amplification of the generic diagnosis; articular facets of the radials), p. 193 (probable occurrence at Singapore); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (closely related to *Ptilometra* which represents it in Australia); Mem. Australian Mus., vol. 4, 1911, p. 725 (absent from Australia), p. 728 (referred to the Thalassometridae); Crinoids of the Indian Ocean, 1912, p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and farther west), p. 24 (range), p. 42 (referred to the Thalassometridae), p. 59 (in key), p. 190 (original reference; type); Unstalked crinoids of the

Siboga Exped., 1918, p. 140 (in key; range; key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 86, 100, 101; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 79, 85, 91, 231.—Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, pp. 151, 156.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.—Ekman, Tiergeographie des Meeres, 1935, p. 283.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 57 (key to the included Australian species).

Diagnosis.—A genus of Asterometridae in which the arms are 10 to 16, though seldom over 13, in number; the pinnules of the proximal third of the arm are much shorter than those of the distal half and are composed of segments which, except occasionally at the extreme tip, do not have overlapping and spinous distal ends; the longer proximal cirrus segments as viewed laterally have approximately straight ventral and dorsal borders, though these may diverge slightly distally; there is no central constriction or production of the distal edge.

Geographical range.—From the Goto Islands and Kagoshima Gulf, southwestern Japan, and the Bonin Islands southward to the Kei Islands and the Sahul Bank (south of western Timor), and westward to Bali.

Bathymetrical range.—From 73 (?72) to 256 meters.

Thermal range.—One record, 15.89° C.

Remarks.—The species of the genus *Asterometra* have a very characteristic appearance, the small number of arms, compact proximal structure and very large cirri distinguishing them at a glance. They are divided into two sections in one of which, including only *anthus*, the division series and arm bases are smoothly convex dorsally, while in the other, including *mirifica*, *cristata*, *macropoda*, and *longicirra*, they are carinate. The species of the last section differ very little except in the extent and degree of the proximal carination.

History.—The first known species of this genus was described under the name of *Antedon longicirra* by Dr. P. H. Carpenter in 1888. This species was transferred to the new genus *Ptilometra* in 1907. When I established the genus *Ptilometra* I said that "I had at first isolated *Alecto macronema*, making it the type of *Ptilometra* and including the other species [*anthus*, *longicirra*, and *macropoda*] in the genus *Asterometra* with *Antedon macropoda* as the type, but further study has led me to combine the two, at least for the present." However, early in 1908 *Asterometra*, with the genotype *Antedon macropoda*, was included in a key to the genera of the family Antedonidae.

Since 1918 when *Asterometra magnipeda* was transferred to *Pterometra* the genus *Asterometra* has been accepted in its present status.

KEY TO THE SPECIES IN THE GENUS ASTEROMETRA

a^1. Elements of the division series and first two brachials with median keels or tubercles, or at least a narrow raised middorsal line.
  b^1. Elements of the division series and first two brachials with a continuous median keel.
    c^1. Keels on the elements of the division series and first two brachials high and conspicuous.
      d^1. Keels on the elements of the division series and first two brachials with the crest strongly convex in profile view so that the profile of the lower part of the animal is formed by a series of scallops (from the Kei Islands and the Sahul Bank westward to Bali; 73–183 meters)---------- **mirifica** (p. 434)
      d^2. Keels on the elements of the division series and first two brachials with the crest straight in profile view and parallel with the longitudinal axes of the ossicles (Philippine Islands and southern Annam; 80 [?72]–146 meters)---------- **cristata** (p. 437)

c^2. Keels on the elements of the division series and first two brachials low, often reduced to a narrow slightly raised line (southwestern Japan; 162–188 meters)..**macropoda** (p. 441)

b^2. IBr_1 with a slightly elongated sharp median tubercle or a short median ridge; axillaries with three tubercles; first two brachials each with a prominent sharp tubercle (Kei Islands; 90–256 meters)..........**longicirra** (p. 439)

a^2. Elements of the division series and first two brachials smoothly convex dorsally (from the Bonin Islands, southwestern Japan, and Formosa southward to the Sahul Bank; 64–185 [?210] meters)..........**anthus** (p. 444)

ASTEROMETRA MIRIFICA A. H. Clark

PLATE 40, FIGURE 208; Plate 42, Figure 216

[See also vol. 1, pt. 1, figs. 43, *a*, *b* (lateral view of the centrodorsal and arm bases), 44 (ventral view of the arm bases), p. 77; pt. 2, fig. 206 (lateral view), p. 143; fig. 207 (lateral view), p. 145.]

Antedon longicirra (part) BELL, Journ. Linn. Soc. (Zool.), vol. 24,1893, p. 339 (Sahul Bank).—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 56.

Asterometra mirifica A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 146 (description; Sahul Bank); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 547 (comparison with *A. cristata*); Mem. Australian Mus., vol. 4, 1911, p. 794 (synonymy; locality); Crinoids of the Indian Ocean, 1912, p. 190 (synonymy; description; Sahul Bank); fig. 33, p. 192; Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 43 (published references to specimens in the B. M.; Sahul Bank; comparison with *A. longicirra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 141 (in key; range; synonymy; notes; stations 260, 294), p. 275 (listed); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 647 (Rotti Strait; 100 fathoms).—SIEVERTS, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, p. 151.—GISLÉN, Ark. Zool., vol. 26A, No. 16, 1933, fig. 11, p. 8 (from A. H. Clark, 1921).—A. H. CLARK, Treubia, vol. 14, livr. 2, 1933, p. 207 (listed), p. 213 (St. Nicolaas Bay; notes).—H. L. CLARK, Echinoderm fauna of Australia, 1946, p. 57 (Sahul Bank).

Diagnostic features.—The elements of the division series and first two brachials have a high thin median carination the crest of which is strongly convex in lateral view so that the lower portion of the animal appears scalloped; 10–15 arms 80–100 mm. long; cirri IX–XIV, 78–108 (usually 90–100), 80–100 mm. long—about as long as the arms.

Description.—Although in general similar to *A. cristata* and to *A. longicirra* this species may be readily distinguished from them by the very high sharp median keels on the elements of the division series and on the first two brachials; these keels are strongly convex in profile so that the outline of the lower portion of the animal consists of a series of convex scallops instead of a straight line as in *A. cristata* or well-spaced angular tubercles as in *A. longicirra*.

Arms 10–15 in number.

Notes.—Of the three specimens from *Siboga* station 260 two are very small and one is nearly of full size. The last resembles very closely the type specimen from the Sahul Bank. The arms are 70 mm. long; the cirri, which are composed of 87–89 segments, are 70–75 mm. long.

Of the 11 specimens from the Danish Expedition to the Kei Islands station 24 three have 10, two 12, two 13, one 14, and three 15 arms.

In one of the specimens with 12 arms the centrodorsal is columnar at the base with the dorsal pole conical, the sides making an angle of somewhat more than 60° with each other. The cirrus sockets are arranged in 10 crowded columns, the sockets in adjacent columns alternating in position; there are one or two sockets to a column.

The cirri are XIV, 93–95, from 90 to 95 mm. long. The first segment is about four times as broad as long, those following increasing in length so that the fourth is twice as broad as long, the sixth is about as long as broad or slightly longer than broad, and the tenth or thirteenth and three to five following are half again as long as broad. The length then slowly decreases so that the segments in the terminal third of the cirri are broader than long, becoming twice as broad as long on the last 25 or 30. Distally when the segments have shortened so that they are about as long as broad a terminal dorsal spine slowly develops which gradually comes to involve the entire dorsal surface of the segments and becomes the typical dorsal spine characteristic of this genus. The tip of the cirri tapers somewhat so that the terminal claw and the penultimate segment are reduced and more or less rudimentary. The ends of the basal rays are indicated by low, broad, inconspicuous swellings. The radials are about four times as broad as long, oblong, in close lateral apposition, with a high and very narrow median keel which rises very abruptly; in profile view the crest of this keel is seen to be convex. The IBr_1 are about twice as long as the radials, about three times as broad as long, oblong, with a high narrow median keel having in profile a more or less convex crest. The IBr_2 (axillaries) are rhombic with the lateral angles truncated, twice as broad as long. The lateral sides are as long as those of the radials, or half as long as those of the IBr_1. They bear a high narrow median keel which curves to one side or the other and does not quite reach the distal border of the ossicle. The IIBr series are 2, resembling the IBr series. The 12 arms are 95 mm. long. The first two brachials have high thin median carinate processes resembling those on the division series, and the following brachials have a similar but much lower median carination which after the brachials become triangular rises into a broad overlapping spine.

A specimen with 13 arms 80 mm. long has the centrodorsal long, truncated conical, twice as high as broad at the base, and the cirri IX, 104–108, 85–100 mm. long. The other specimen with 13 arms has three IIBr 2 series, each on a different postradial series.

A specimen with 15 arms 80 mm. long has the cirri IX, 78–95, 80–95 mm. long. Another with 14 arms 85 mm. long has the cirri XII, 89–90, 85 mm. long. A small specimen with 10 arms 60 mm. long has the cirri 55 mm. long.

Prof. F. Jeffrey Bell regarded all the specimens from the Sahul Bank (representing *A. mirifica* and *A. anthus*) as belonging to Carpenter's *longicirra*. He said:

> Dr. Carpenter founded this species on a single specimen and was therefore unacquainted with the very considerable range of variation in the length of the cirri in different specimens of this species. While one specimen may have cirri 80 or more millim. long, as in the type, in others the cirri may not be more than 60 millim. long. In this point, therefore, the cirri may be more like those of *A. incerta* than of *A. longicirra*. The present specimens are shown, by the simple condition of the second pinnule and the comparative shortness of the joints of the cirri, to belong to *A. longicirra*. When I first noticed the variation in the length of the cirri, I thought it might be possible to show that the two species (*A. incerta* and *A. longicirra*) should be united. The other distinctive characters, however, on which Carpenter insists seem, so far as *A. longicirra* is concerned, to be constant, and with the present condition of our collections the species can still be readily distinguished.

The description of the species as given is based upon the single specimen from the Sahul Bank, the type, in the Indian Museum at Calcutta. In 1910 I examined three additional specimens in the British Museum. One of these has the arms 105 mm.

long and the cirri 87 mm. long. Another is similar. The third is very small with the arms only 35 mm. long, but it has already developed the compressed and overlapping brachials and the strong proximal carination of the adults. I remarked that this species is very easily distinguished from *A. longicirra*, with the type of which I was able to compare it directly, by the stout high keels on the elements of the IBr series and first two brachials which are practically confluent on succeeding ossicles; the axillaries bear a single sharp keel.

The material from *Siboga* station 294 consisted of five very small specimens and a few cirri from larger examples. Speaking of all the specimens from *Siboga* stations 260 and 294 I said that the keels on the elements of the IBr series and on the first two brachials are considerably higher in this species than in *A. cristata*.

One of the specimens from St. Nicolaas Bay, Bali, has 11 arms 100 mm. long, one IIBr 2 series being present; the longest cirri have 93 segments. Another specimen has 10 arms 100 mm. long; the longest cirri have 95 segments. The two other specimens are small; each has 10 arms.

Localities.—*Siboga* station 260; 2.3 miles N. 63° W. from the north point of Nuhu Jaan, Kei Islands (lat. 5°36′30″ S., long. 132°55′12″ E.); 90 meters; sand, coral, and shells; December 16, 18, 1899 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 24 (11, U. S. N. M., E. 3183; C. M.).

Sahul Bank, south of the southern end of Timor (lat. 11°30′ S., long. 125° E.); from a cable [Bell, 1893; A. H. Clark, 1909, 1911, 1912, 1913, 1918; Sieverts, 1932; Gislén, 1933] (4, B. M.; I. M.).

Siboga station 294; Timor Sea, south of southwestern Timor (lat. 10°12′12″ S., long. 124°27′18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1918] (5, U. S. N. M., E. 415; Amsterdam Mus.).

Rotti Strait, between southwestern Timor and Rotti; 183 meters; cable repair ship *Cable*, Eastern and Associated Telegraph Co.; from the Banjuwangi-Darwin No. 2 cable [A. H. Clark, 1929] (2, B. M.).

St. Nicolaas Bay, western end of Bali; September 7, 1909 [A. H. Clark, 1933] (4, Buitenzorg Mus.).

Geographical range.—From the Kei Islands and the Sahul Bank, south of southwestern Timor, westward to Bali.

Bathymetrical range.—From 73 to 183 meters; but it undoubtedly occurs also in water of lesser depth.

History.—Dr. John Anderson, the superintendent of the Indian Museum at Calcutta, sent to Dr. Philip Herbert Carpenter a small collection of crinoids that had been taken from a cable crossing the Sahul Bank. Dr. Carpenter was apparently unable to devote any time to studying this collection, for he made no notes in connection with it. After his death J. Wood-Mason, who had succeeded Dr. Anderson as superintendent of the Indian Museum, transferred the collection to Prof. Francis Jeffrey Bell, who published a report upon it in 1893. In the collection were several specimens identified by Professor Bell as *Antedon longicirra*. Most of these were of the present species, but one represents *A. anthus*. Many years later Dr. Nelson Annandale, then the Superintendent of the Indian Museum, sent all the crinoids of that institution to Dr. Francis Arthur Bather for study. Dr. Bather was so kind as to suggest that they be forwarded to me. In the collection was a specimen from the Sahul Bank that had been determined by Professor Bell as *Antedon longicirra.* This I described under the name of *Asterometra mirifica* in 1909, comparing it with *A. cristata,* new species, in 1911, and redescribing and figuring it in 1912.

In 1910 I examined three specimens of *Asterometra mirifica* in the British Museum from the Sahul Bank that had been identified as *longicirra* by Bell and in 1913 recorded and gave notes on them. In my report on the recent crinoids of the *Siboga* expedition published in 1918 I recorded and gave notes on additional specimens from *Siboga* stations 260 and 294. In 1929 I recorded this species from Rotti Strait where it had been found on the Banjuwangi-Darwin No. 2 cable by the cable repair ship *Cable* of the Eastern and Associated Telegraph Company. This species was mentioned by Dr. H. Sieverts in 1932, and in 1933 Prof. Torsten Gislén reproduced the figure of it given in Part 2, fig. 207, p. 145. In 1933 I recorded and gave notes on some specimens from St. Nicolaas Bay, Bali, in the Buitenzorg Museum in Java.

ASTEROMETRA CRISTATA A. H. Clark

PLATE 40, FIGURES 209, 210; PLATE 42, FIGURE 217

Asterometra cristata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 547 (description; *Albatross* stations 5483, 5482; abnormal specimen); Crinoids of the Indian Ocean, 1912, p. 190 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 141 (in key; range); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 647 (off Cape Padaran; 80 fathoms; notes).—GISLÉN, Kungl. Fysiogr. Sällsk. Lund Förh., vol. 7, No. 1, 1936, p. 2 (southern Annam), p. 5 (French Indo-China), p. 6 (range).—A. H. CLARK, Temminckia, vol. 1, 1936, p. 312 (*Willebrord Snellius* station 60*; notes).

Diagnostic features.—The elements of the division series and first two brachials have a high thin median carination the crest of which is straight and parallel with the long axes of the ossicles; 10–12 (usually 10) arms 90–110 (usually about 100) mm. long, relatively more slender than in the other species of the genus; the first 12 brachials may have the proximal edge more or less thickened, giving the arm bases a somewhat rough appearance and a slightly, but very distinctly, serrate profile with the teeth directed downward and outward; cirri about XX, 77–107 (usually 80–90), 55–80 (usually 70–80) mm. long—about three-fourths of the length of the arms.

Description.—This species is in general similar to *A. longicirra* from the Kei Islands and to *A. mirifica* from the Sahul Bank.

The centrodorsal is conical with the cirrus sockets in 10 closely placed columns, 2, more rarely 3, sockets to a column.

The cirri in the type specimen are XX, 77–86, from 60 to 65 mm. long, rather short, moderately stout, especially basally, ventrally rounded-carinate in the proximal half, the distal ventral edge of the short proximal segments being rather strongly produced, this character gradually dying away as the segments become longer.

The IBr series and first two brachials bear a narrow, sharp, very prominent median keel of uniform height which is not nearly so high nor so sharp as that in *A. mirifica.* In the latter the keels are seen in profile to be rather strongly convex along the apex, giving a characteristic scalloped appearance to the lower part of the animal; in the present species the crest is straight so that the profile view of the animal is not altered.

The 10 arms are 100 mm. long, relatively more slender than the arms of related species.

Notes.—One of the three specimens from off Cape Padaran, southern Annam, has the arms about 90 mm. long, and the longest cirri about 70 mm. long with 83–85 segments.

Of the five specimens from *Albatross* station 5482 one has 10 arms 90 mm. long and the cirri 55–60 mm. long with 77–82 segments. Another has 10 arms 100 mm. long and the cirri 75–80 mm. long with 82–107 segments. A third is similar. The fourth specimen has 11 arms 100 mm. long, one IIBr 2 series being present, and the cirri 60–70 mm. long with 85–94 segments. The fifth specimen is abnormal.

Of the five specimens from *Willebrord Snellius* Station 60* one has 12 arms 100 mm. long, two IIBr 2 series being present, and the cirri 70 mm. long. The four others all have 10 arms. In one the arms are 110 mm. long, and the longest cirri are 73 mm. long. In another the arms are 100 mm. long, and the longest cirri are 60 mm. long; in this specimen the first twelve brachials have the proximal edge more or less thickened, giving the arm bases a somewhat rough appearance and a slightly, but very distinctly, serrate profile with the teeth directed downward and outward. This feature also occurs in the type specimen from *Albatross* station 5483. In one specimen the sides of the arms are heavily mottled with brownish, the mottlings forming a frequently interrupted broad lateral line which here and there becomes a row of blotches or spots. The other specimens all show the lateral mottled line on the arms more of less distinctly, but only one other shows the proximal median line. The dark lateral line is also traceable in the type specimen.

Localities.—Off Cape Padaran, southern Annam (lat. 11°38′ N., long. 109°41′ E.); 146 meters; cable repair ship *Patrol*, Eastern and Associated Telegraph Company; from the Cape St. James-Hong Kong cable; R. H. Ellis, June 4, 1927 [A. H. Clark, 1929; Gislén, 1936] (3, B. M.).

Albatross station 5483; between Samar and Leyte, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 88° W., 5.7 miles distant (lat. 10°27′30″ N., long. 125°19′15″ E.); 135 meters; sand and broken shells; July 30, 1909 [A. H. Clark, 1911, 1912, 1918] (1, U.S.N.M., 27496).

Albatross station 5482; between Samar and Leyte, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 87° W., 4.5 miles distant (lat. 10°27′30″ N., long. 125°18′00″ E.); 122 meters; broken shells, sand, and green mud; July 30, 1909 [A. H. Clark, 1911, 1912, 1918] (5, U.S.N.M., 35557, 35558, 35626, 35633, 35634).

Albatross station 5356; North Balabac Strait; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°15′45″ E.); 106 meters; sand and shells; January 5, 1909 (1, U.S.N.M., 36032).

Willebrord Snellius station 60*; west of Zamboanga, Mindanao (lat. 6°58′00″ N., long. 121°52′30″ E.); 72–80 meters; September 5, 1929 [A. H. Clark, 1936] (5, U.S.N.M., E. 5282; L. M.).

Geographical range.—Philippine Islands and southern Annam.

Bathymetrical range.—From 80 (?72) to 146 meters.

History.—This species was described in 1911 from a specimen that had been dredged by the *Albatross* at station 5483 in the Philippine Islands. At the same time five additional specimens were recorded from station 5482, and notes on them were given. In my monograph on the crinoids of the Indian Ocean published in 1912 I listed this species and gave the synonymy and range. In my memoir on the unstalked crinoids of the *Siboga* expedition I inserted the species in a key to the species of *Asterometra* and gave the range. In 1929 I recorded three specimens that had been found on the Cape St. James–Hong Kong cable off Cape Padaran in 80 fathoms by Mr. R. H. Ellis of the cable repair ship *Patrol.* This record was cited by Prof. Torsten Gislén in his account of a collection of crinoids from French Indo-China and the Macclesfield Bank published in 1936. In 1936 I recorded and gave notes on 5 specimens dredged by the *Willebrord Snellius* off Zamboanga in southern Mindanao.

ASTEROMETRA LONGICIRRA (P. H. Carpenter)

Antedon longicirra P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 103 (description; *Challenger* station 192); pl. 17.—Bell, Journ. Linn. Soc. (Zool.), vol. 24, 1893, p. 339.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 130 (systematic and bathymetrical relationships).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 136 (comparison with *A. anthus*).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Antedon longicirri S. and R. M. Pace, Zool. Rec., V. Echinoderma, 1907, Dec. 1908, p. 38 Ech. (editorial error).

Ptilometra longicirra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359 (listed).

Asterometra longicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 147 (compared with *A. mirifica*); Vid. Medd. Naturh. Foren. København, 1909, p. 182 (compared with *A. lepida* [*anthus*]); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 547 (compared with *A. cristata*); Crinoids of the Indian Ocean, 1912, p. 33 (identity); p. 190 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 43 (published references to specimens in the B. M.; *Challenger* station 192; characters); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 141 (in key; range), p. 142 (synonymy; notes; station 260), p. 275 (listed).

Antedon longicina Zool. Rec. for 1912, 1913, p. 54 Echin.

Diagnostic features.—The IBr_1 have a slightly elongated sharp median tubercle or a short median ridge, the axillaries have three tubercles, and the first two brachials each have a prominent sharp tubercle; 10 arms 100–105 mm. long; cirri X–XX, 80–98, 70–80 mm. long.

Description.—The centrodorsal is subconical with the cirrus sockets arranged in 10 columns.

The cirri are about XX, about 80, 80 mm. or more in length. The longest proximal segments are longer than broad. The middle segments are slightly compressed laterally and gradually develop a dorsal keel which becomes rather large on the shorter terminal segments but is much reduced in size toward the end. The terminal claw is very small.

The ends of the basal rays are just visible above the centrodorsal.

The radials are rather long and oblong. The IBr_1 are oblong. The IBr_2 (axillaries) are pentagonal. The IBr_2 and the first two brachials have sharp lateral edges and flattened sides. The IBr_1 are very convex dorsally and bear a short median ridge or tubercle that rises to a sharp angle in the middle. The IBr_2 bear three more or less pointed tubercles.

The 10 arms are about 100 mm. long and consist of over 100 brachials of which the lower are triangular, broader than long, and those succeeding gradually become carinate so as to develop a forward-projecting dorsal spine. Beyond the thirtieth the brachials become laterally compressed and begin to overlap. This is reduced again in the last few, which diminish rather rapidly in size.

Syzygies occur between brachials 3+4 and 12+13, and distally at intervals of 5 or 6 muscular articulations.

The pinnules are all stiff and styliform and consist of elongated segments. Those of the first pair (P_1 and P_a) are relatively small, those of the second pair (P_2 and P_b) considerably larger.

The disk and ambulacra are well plated, but the side- and covering-plates are not well differentiated on the pinnules.

Sacculi are very rare, or absent altogether.

The color in alcohol is light whitish brown.

Notes.—The preceding description is that of Carpenter with the addition of a few notes I made on the type specimen during a visit to the British Museum in 1910.

In the specimen from *Siboga* station 260 the centrodorsal is columnal, 5.5 mm. broad at the base and 3 mm. in interradial height. The cirrus sockets are arranged in 10 columns of 2 each. The columns of adjacent radial areas are close together, separated by a slightly marked irregular rounded ridge which in width is equal to from one-half to one-third the diameter of the adjacent sockets. The two columns of each radial area are separated in the midradial line by a slightly concave bare space equal in width to about one-half the diameter of a cirrus socket. The dorsal pole is slightly concave and is marked by five large, though low and obscure, tubercles as in the other species of the genus.

The cirri are about X, 87–98, from 70 to 80 mm. long, moderately slender. The longest proximal cirrus segments are about twice as long as broad.

The ends of the basal rays are prominent as small tubercles in the angles of the calyx.

The radials have a prominent median dorsoventrally elongated tubercle. The IBr_1 and the proximal third or half of the axillary bear a narrow low rounded median carination, on the former highest distally, on the latter highest proximally, the highest points being marked usually by a slight elevation in the general surface. Traces of this are seen on the first two brachials. In some cases there is a tubercle toward the distal border of the IBr_1, and a similar tubercle toward the proximal border of the axillary, the latter with faint traces of broad tubercles anterior to and on either side of it; each of the first two brachials also bears a tubercle.

The 10 arms are 105 mm. long.

This appears undoubtedly to be an undeveloped individual of *A. longicirra*. The cirri are more slender than those of the type specimen and are composed of relatively longer segments, and the ornamentation of the elements of the IBr series and first two brachials is scarcely more than indicated.

Localities.—*Challenger* station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud, September 26, 1874 [P. H. Carpenter, 1888; Bell, 1893 (part); Hartlaub, 1895; A. H. Clark, 1907, 1909, 1911, 1912, 1913, 1918] (1, B. M.).

Siboga station 260; 2.3 miles N. 63° W. from the northern point of Nuhu Jaan, Kei Islands (lat. 5°36′30″ S. long. 132°55′12″ E.); 90 meters; sand, coral, and shells; December 16, 18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—Known only from the Kei Islands.

Bathymetrical range.—From 90 to 256 meters.

History.—This species was first described under the name of *Antedon longicirra* by Dr. P. H. Carpenter from a single specimen that had been dredged by the *Challenger* near the Kei Islands in 1874. I transferred *longicirra* to the genus *Ptilometra* in 1907 and to the genus *Asterometra* in 1909. In 1910 I examined the type specimen in the British Museum and published notes on it in 1913. In 1918 I recorded and gave notes on another specimen of *Asterometra longicirra* that had been dredged at the Kei Islands by the *Siboga* in 1899.

ASTEROMETRA MACROPODA (A. H. Clark)

PLATE 41, FIGURE 211

[See also vol. 1. pt. 1, fig. 94 (lateral view), p. 155; figs. 189, 190 (centrodorsal), p. 235; fig. 268 (ventral view of centrodorsal), p. 259; fig. 309 (habitus), p. 267; fig. 362 (cirrus), p. 295; fig. 482 (dorsal view of the radial pentagon), p. 363; pt. 2, figs. 69, 70 (radial pentagon), p. 43; fig. 285 (pinnules), p. 215; figs. 517–520 (pinnule tips), p. 283; figs. 812–815 (side- and covering-plates, p. 385.].

Antedon macropoda A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 136 (description; *Albatross* station 4935); Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 358 (type of *Asterometra*); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (same).

Ptilometra macropoda A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359 (listed).

Asterometra macropoda A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 229 (compared with *A. lepida*); Vid. Medd. Naturh. Foren. København, 1909, p. 181 (same); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 546 (arms compared with those of *A. magnipeda*); Crinoids of the Indian Ocean, 1912, p. 193 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 141 (in key; range); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 3, fig. 32 (proportions of the cirri), pl. 10, fig. 46.—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1932, p. 5 (163 meters), p. 6 (Kiu Shui and Goto Islands), p. 101 (station 12; detailed notes), p. 180 (listed), figs. 99, 100, p. 122; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 3 (station 9; 162 meters), p. 42 (station 9; notes), p. 43 (comparisons), p. 68 (listed).—SIEVERTS, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, p. 156.

Diagnostic features.—The elements of the division series and first two brachials have a low sharp median keel which may be reduced to a slightly raised median line; 10–12 (usually 10) arms 65–95 mm. long; cirri X–XVI, 55–130 (usually 80–90), 45–100 (usually 60–80) mm. long, frequently as long as or even longer than the arms.

Description.—The centrodorsal is long, columnar, becoming truncated conical beyond the cirri, marked with obsolete interradial ridges; the apical crater bears sometimes 5 large tubercles which are interradial in position, and sometimes a number of small ones which are irregularly placed. The cirrus sockets are arranged in 10 very closely placed columns.

The cirri are XV, 100–130, 100 mm. in length, usually somewhat longer than the arms, and very stout, the width in lateral view increasing distally, then diminishing again at the tip.

The radials are somewhat over twice as broad as long, with a strong median dorsal tubercle. The IBr and IIBr series have a sharp median keel.

The 10–12 arms are 95 mm. long.

Syzygies occur between brachials 3+4, again between brachials 10+11 or 12+13, and distally at intervals of 5 or 6 muscular articulations.

P_1 has 13 segments, and is only slightly shorter than P_2, which has 10 segments. The distal pinnules have about 15 segments. The terminal pinnules extend for 3 mm. or 4 mm. beyond the tips of the arms.

Notes.—In the specimen collected by Capt. H. Christiansen south of the Goto Islands the arms are 95 mm. long and the cirri are X, 82–89, 70–80 mm. long. The elements of the division series and first two brachials are narrowly subcarinate, with a median slightly raised line.

In one of the two specimens from Dr. Sixten Bock's station 12, according to Gislén, the centrodorsal is 3 mm. broad at the base with a visible height of 2 mm.; the dorsal pole bears 5 radial tubercles close together arranged around a small central cavity. The cirri are XVI, 55–75, 45–55 mm. long, in five groups separated by inconspicuous radial interspaces. The segments from the tenth to the twenty-fifth are from one-third to half again as long as broad. From about the thirtieth segment the length equals the width, from the fortieth the segments are half again as broad as long, and the distal are twice as broad as long. At about the twenty-fifth segment the cirrus becomes serrate on the dorsal side in lateral profile, the height of the dorsal spines being one-quarter the width of the segments, on the distal segments less. The opposing spine is one-third the width of the penultimate segment. The terminal claw is a little shorter than the penultimate segment. The cirri are laterally compressed.

The radials are three times as broad as long with a small well circumscribed median tubercle. The IBr_1 are somewhat broader than the radials, in close contact laterally and joined to the IBr_2 by a close synarthry. The IBr_2 (axillaries) are twice as broad as long. There is no synarthrial tubercle on the IBr series. The ossicles are laterally flattened as far as the fourth brachial.

The 10 arms are 65 mm. long. The first brachials are interiorly united for about one-third of their length; like the second brachials, they are longer exteriorly than interiorly. After the tenth the brachials become oblique. After the fiftieth (to sixtieth) brachial there is a prominent median distally directed dorsal crest which on the outermost brachials becomes a strong spine rising to a height of from one-third to one-half the width of the brachial when viewed laterally. Seven or eight of the terminal brachials have only rudimentary pinnules.

Syzygies usually occur between brachials 3+4, 21+22, 32+33, 42+43, etc., with an interval of 8–10 muscular articulations. On one postradial series one of the arms has syzygies between brachials 3+4, 5+6, 22+23, and 38+39, while the other arm has the first syzygy between brachials 27+28.

P_1 is about 5 mm. long with 9 or 10 segments, stout and thick, with prismatic segments of which the first two are short and those following are somewhat longer than broad. P_a is 5 mm. long with 10 segments and is a little more slender. P_2 is 5 mm. long with 8–10 segments. P_3 is similar. The distal pinnules are 6.5 mm. long with 16 segments. The disk has been thrown off. The color in alcohol is white.

In the other specimen from Dr. Sixten Bock's station 12 the cirri are XV, 85–90, 75–80 mm. long; a dorsal spine is developed from the fortieth segment onward. There is a slight synarthrial prominence on the IBr series; each of the ossicles of the

IBr series has a central inconspicuous small wart, and the IBr_2 (axillary) has in addition two low ridges starting from the wart and running proximo-laterally. The 10 arms are 70 mm. long. A dorsal spine is developed from about the fiftieth brachial. There are eight rudimentary terminal brachials. On one arm syzygies occur between brachials 3+4, 9+10, 13+14, 19+20; and on another between brachials 3+4, (7+8), 14+15, 19+20, 26+27, 32+33, and 44+45. P_1 is 5.5 mm. long with 13 segments. P_2 is 5.7 mm. long with 10 segments. P_3 has 11 segments. P_4 is 6 mm. long with 12 segments. P_a has 14 segments. P_b, which is of about the same length, has 11 segments. The distal pinnules are 7 mm. long with 16–20 segments of which the first two are shorter and a little broader than those following, which are half again as long as broad. The pinnules are laterally compressed and have a dorsal ridge. The disk has been thrown off.

Professor Gislén said that these specimens are closely related to *A. macropoda* from which they differ by having almost smooth proximal brachials. The first is a rather young individual with cirri shorter than the arms. The radial dorsal tubercles of the centrodorsal are, however, well developed and by these it may easily be distinguished from *A. anthus*. The dorsal spines of the cirri are not so prominent and pointed as in *A. anthus*.

In one of the two specimens from Dr. Mortensen's station 9, according to Gislén, the centrodorsal is 3.5 mm. high. The cirri are XIV, 98–103, up to 80 mm. in length. The radials bear a stout median tubercle. The elements of the IBr series and the first 2 brachials have a weak mediodorsal carination. The 10 arms are 65 mm. long. P_1 is 4.5 mm. long with 10 segments. P_2 is 4.5 mm. long with 10 segments. P_3 is 5 mm. long with 11 segments. P_{11} is 7 mm. long with 12 segments.

In the other specimen the cirri are 70 mm. long and the 10 arms are 75 mm. long. The median carination on the elements of the IBr series and first two brachials is more pronounced, on the IBr_2 (axillaries) divided into two low successive tubercles.

Localities.—Albatross station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 58° E., 4.5 miles distant (lat. 30°57′20″ N., long. 13°35′10″ E.); 188 meters; bottom temperature 15.89° C.; stones; August 16, 1906 [A. H. Clark, 1907, 1908, 1909, 1911, 1912, 1915, 1918, 1921; Sieverts, 1932] (4, U.S.N.M., 22626, 35627, 35628, 36184; M. C. Z., 359).

South of the Goto Islands (lat. 32°15′ N., long. 128°20′ E.); 183 meters; Capt. H. Christiansen, April 17, 1926 (1, C. M.).

Dr. Sixten Bock's Expedition to Japan station 12, which is the same as Dr. Th. Mortensen Pacific Expedition station 9; the coral bank, Goto Islands, off southwestern Japan (lat. 32°15′ N., long. 128°12′ E.); 162 meters; hard bottom; May 15, 1914 [Gislén, 1922, 1927].

Geographical range.—Northern part of the Eastern Sea from off Kagoshima Gulf northward to the Goto Islands.

Bathymetrical range.—From 162 to 188 meters.

History.—This species was described as *Antedon macropoda* in 1907 from four specimens dredged at *Albatross* station 4935 in the previous year. Later in the same year it was transferred to the new genus *Ptilometra* and the new genus *Asterometra* was tentatively suggested for its reception, a disposition that was confirmed early in 1908.

In 1922 Prof. Torsten Gislén recorded and gave notes on two specimens from Dr. Sixten Bock's Expedition to Japan station 12, and in 1927 he recorded and gave notes on two more from Dr. Th. Mortensen's Pacific Expedition station 9. Drs. Bock and Mortensen worked in cooperation in southern Japan, and Bock's station 12 and Mortensen's station 9 were in reality the same station, occupied by them jointly.

ASTEROMETRA ANTHUS (A. H. Clark)

Plate 36, Figure 194; Plate 41, Figures 212–214; Plate 42, Figure 215

[See also vol. 1, pt. 1, figs. 49, *a*, *b* (tip of distal pinnule), 53 (distal pinnule), 54 (articular face of a pinnular), p. 81; pt. 2, fig. 209 (lateral view), p. 149.]

Antedon longicirra (part) Bell, Journ.Linn. Soc. (Zool.), vol. 24, 1893, p. 339 (Sahul Bank).—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 56.

Antedon anthus A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 136 (description; *Albatross* station 4936), p. 137 (comparison of pinnules with those of *A.* [*Asterometra*] *macropoda*).

Ptilometra anthus A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359 (listed).

Asterometra anthus A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 229 (compared with *A. lepida*); vol. 22, 1909, p. 147 (compared with *A. acerba*); Vid. Medd. Naturh. Foren. København, 1909, p. 181 (compared with *A. lepida*); Crinoids of the Indian Ocean, 1912, p. 193 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga* Exped., 1918, p. 141 (in key; range).—Gislén, Nova Act Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 5 (127–209 meters), p. 6 (Bonin Islands), pp. 7, 9 (includes *A. acerba* and *A. lepida*), p. 10, p. 102 (compared with *A. macropoda*), p. 103 (synonymy [includes *acerba* and *lepida*], Bock's stations 45, 46, 47, 53, 54, 55, 56, 57, 59; detailed notes and comparisons), pp. 182, 183 (listed), figs. 92–97, p. 112, fig. 98, p. 122, pl. 2, fig. 16; Zool. Bidrag Uppsala, vol. 9, 1924, p. 14 (arm regeneration), pp. 21, 28, 41 (measurements), pp. 42, 44, 46, 51, 53, 79, 206, 215, 275, 278 (Bonin Islands, 180 meters; food), pp. 284, 285 (Bonin Islands, 207 meters; details), fig. 78, p. 81, fig. 106, p. 87, figs. 173, 174, p. 98, figs. 274–277, 288, p. 209, fig. 299, p. 217, fig. 340, p. 281; Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 3 (station 9; 162 meters), p. 42 (station 9; notes), p. 43 (comparisons), p. 68 (listed).—Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, p. 156.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Asterometra lepida A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 229 (Straits of Formosa, 35 fms.); Vid. Medd. Naturh. Foren. København, 1909, p. 181 (further description); Crinoids of the Indian Ocean, 1912, p. 195 (synonymy; locality).—Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in eastern Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 140 (in key; range).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 9 (synonym of *A. anthus*), pp. 113, 114 (comparison with *A. anthus*), fig. 95, p. 112.—Sieverts, Neues Jahrb. Min., Geol. und Pal., vol. 69, Beilage-Band, Abt. B, 1932, pp. 151, 156.

Asterometra acerba A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 147 (description; Sahul Bank); Mem. Australian Mus., vol. 4, 1911, p. 795 (synonymy; locality); Crinoids of the Indian Ocean, 1912, p. 193 (synonymy; detailed description; locality), fig. 34, *a*, *b*, p. 194; Unstalked crinoids of the *Siboga*-Exped., 1918, p. 141 (in key; range).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 9 (synonym of *A. anthus*), pp. 103, 113 (comparison with *A. anthus*), fig. 93, p. 112.—H. L. Clark, Echinoderm fauna of Australia, 1946, p. 57 (Sahul Bank).

Astererometra anthus Gislén, Nova Acta Reg. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 86.

Diagnostic features.—The elements of the division series and first two brachials are rounded dorsally without any trace of a median carination; 10–16 arms, about half the individuals having 10 and very few more than 12; the arms in fully grown individuals are 70–105 (most commonly 75–90) mm. long; cirri XI–XXIII (usually XVI–XX), 60–100 (usually 75–85), 55–73 (usually 55–65) mm. long.

Description.—The centrodorsal is columnar with the tip conical, truncated, with an apical crater surrounded by 5 prominent tubercles which are interradially situated. Low ridges run from each of these tubercles along the conical portion of the centrodorsal as far as the distal cirri. The cirrus sockets are arranged in 10 columns, the 2 columns in each radial area being separated from those in the adjacent radial areas by bare lines or shallow grooves which are equal in width to from half to three-quarters of the transverse diameters of the cirrus sockets.

The cirri are XX, 80, 60 mm. in length, fairly uniform in width but tapering at the tip. The first six or seven segments bear prominent dorsal spines and the following are smooth to about the twentieth where the cirri begin to become compressed and dorsal spines begin to develop which become prominent distally. The terminal claw is minute, bluntly conical, less than the penultimate segment in length.

The radials are somewhat over twice as broad as long with a blunt median tubercle. The elements of the IBr series are rounded, but not very convex, with no trace of a median keel or tubercle. The IIBr series are 2, similar to the IBr series, but with the component ossicles relatively somewhat longer.

The 13 arms in the type specimen are 80 mm. long, or one-third again as long as the cirri.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 15+16, and distally at intervals of from 3 to 6 (usually about 5) muscular articulations.

P_1 is one-third shorter than P_2, stout basally and tapering rapidly to a point, with 9 segments. P_2 is 7 mm. long with 12 segments. The following pinnules decrease very slightly in length, then increase slightly again distally. The terminal pinnules extend for 1.5 mm. or 2 mm. beyond the tip of the arm.

Notes.—The description given above is from the type specimen from *Albatross* station 4936. The specimen from the Formosa Strait in 64 meters was described as a new species, *Asterometra lepida*, in the following terms:

The centrodorsal is rounded-conical, about as long as broad at the base, with the cirrus sockets arranged in 10 crowded, but regular, columns of usually 2 each, two columns to each radial area. The cirri are lacking, but as the centrodorsal and the cirrus sockets are proportionately smaller than in the three other species of the genus (*macropoda*, *longicirra*, and *anthus*) it may be inferred that the cirri are either shorter, or more slender, or both. The disk is lacking. The brachial and pinnule ambulacra are protected by large covering-plates as in the other species of the genus. The radials are short, about four times as broad as long, with a prominent tubercle in the midradial line. The IBr_1 are oblong, approximately three times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, not quite twice as broad as long. The IIBr series are 2. The 11 arms are 70 mm. long, resembling those of the other species of the genus but somewhat more slender basally. P_1 is 5.5 mm. long, styliform, with 10 segments of which the first is not quite so long as broad, the second is slightly longer than broad, and the third and following are slightly longer than the second. P_2 is 6.5 mm. long with 12 segments resembling P_1 and of the same diameter basally though, on account of its greater length, tapering more gradually. P_3 is similar to

P_2, with the same number of segments, but somewhat stouter. The following pinnules gradually increase in length and in the number of their component segments, the segments in the terminal portion becoming proportionately more elongated. P_{10} is 9 mm. long and the distal pinnules are 12 mm. long with 15–17 segments of which the first is about twice as broad as long, the second is about as long as broad, the third is about one-third again as long as broad, and those following increase very gradually in length, being distally about three times as long as broad. The color in alcohol is brownish white.

Additional details were given in 1909. The first brachials are wedge-shaped, rather longer outwardly than inwardly, inwardly united for their entire length. The second brachials are similar in shape and size but are united interiorly. The first syzygial pair (composed of brachials 3+4) is oblong, about twice as broad as long. The next two brachials are oblong, about three times as broad as long, those following becoming wedge-shaped, and triangular about half again as broad as long after the tenth. The terminal four to six brachials are very short and abruptly incurved, the terminal pinnules reaching about 4 mm. beyond them as in the other species of the genus. The IBr series and the first 9 or 10 brachials are in close apposition and sharply flattened laterally. The arms in the proximal half are rounded dorsally, but after the middle gradually become compressed and strongly carinate, the brachials developing strong overlapping spines. Syzygies occur between brachials 3+4, again from between brachials 5+6 to between brachials 13+14 (usually between brachials 12+13 or 13+14, with sometimes an extra one between brachials 7+8) and distally at intervals of 4–7 (usually 5 or 6) muscular articulations.

I wrote that the most obvious distinguishing characters of this species are the small rounded-conical centrodorsal bearing comparatively small cirrus sockets and the smoothness and slenderness of the lower part of the animal. From the base of the centrodorsal the increase in width is gradual and regular, reaching a maximum at about the level of the first syzygy. In *A. macropoda* and in *A. anthus,* I said, the cirrus sockets are much larger, the centrodorsal is columnar for most of its length, and the diameter of the animal increases rapidly to the distal end of the IBr_1 but more gradually from then on so that the opposite sides of the animal are more nearly parallel. This gives these species a peculiarly robust appearance in contrast to the more slender *A. lepida.* While the basal portion of *A. longicirra* increases uniformly in thickness, the increase is much more rapid than in *A. lepida; A. longicirra* is a considerably stouter and more robust species with a larger centrodorsal, and the IBr series are sharply tubercular, a character quite absent in *A. lepida.* The muscular fossae on the articular faces of the radials in *A. lepida* resemble those of *A. macropoda.*

The 14 specimens from Mortensen's station 9 according to Gislén present the following features. (1) The cirri are XIII, 60–71, 37–54 mm. long; the 10 arms are 57 mm. long; there is no carination of the IBr series; P_1 is 4.6 mm. long with 10 segments; P_2 is 4.8 mm. long with 10 segments; the distal pinnules are 8.2 mm. long with 18 segments. (2) The cirri are XVII, with up to 74 segments, 35–60 mm. long; the 11 arms are 60 mm. long. (3) The arms are 10 in number, all broken. (4) The cirri are XVI, with up to 75 segments, up to 60 mm. long; the 10 arms are 65 mm. long. (5) The cirri have about 75 segments and are 50 mm. long; the 11 arms are

65 mm. long. (6) The cirri are 35–45 mm. long; there are 10 arms, all broken. (7) The cirri are 45–55 mm. long, and the 10 arms are 55 mm. long. (8) The cirri are 35–50 mm. long; the 10 arms are all broken. (9) The cirri are 45–50 mm. long; the 12 arms are 55 mm. long. (10) The cirri are 45–50 mm. long, and the 12 arms are 70 mm. long. (11) The cirri are 40–50 mm. long, and the 10 arms are 65 mm. long. (12) The cirri have up to 75 segments and are 50–60 mm. long; the 11 arms are 70 mm. long. (13) The cirri are 50 mm. long; the 10 arms are broken. (14) The cirri and the 10 arms are broken.

In the specimen collected by Capt. H. Christiansen south of the Goto Islands the arms are 58 mm. long and the cirri are XII, 50–56, 35–45 mm. long.

In a specimen from Bock's station 45, according to Gislén, the cirri are XI, 27–34, 7–10 mm. long. The fifth-seventh cirrus segments are half again as long as broad, and the distal segments are as long as broad; a short dorsal spine is developed from the tenth segment onward. The basals project interradially as small prominences. The radials are half again as long as broad, in lateral apposition, with a strong longitudinal crest ending proximally in a blunt spine. The IBr_1 are twice as broad as long. There is a slight synarthrial carination. The 10 arms are 15 mm. long, "wall-sided," with small lateral crests as far as the second brachials. The entire arm has 40 brachials, which develop a dorsal spine from the twenty-fifth onward. The distal intersyzygial interval is 5 muscular articulations. P_1 is 2.3 mm. long with 7 segments. P_2 is 2 mm. long with 7 segments. P_3 is 9 mm. long. The distal pinnules are 5 mm. long with 13 segments which have small spiny whorls on the distal ends; the third and fourth segments are three times as long as broad.

In another specimen from Bock's station 45 the cirri are XII, 26–36, 7–11 mm. long. The 10 arms are 18 mm. long; the distal intersyzygial interval is 4 muscular articulations. P_1 is 2.3 mm. long with 8 segments. P_2 has 8 segments. The distal pinnules are 5 mm. long with 13 segments.

A third specimen from station 45 has the cirri XVI, 23–32, 5–10 mm. long. The 10 arms are 15 mm. long. P_1 is 2.5 mm. long with 9 segments. P_2 is 2.1 mm. long with 8 segments. P_3 is 3.2 mm. long with 10 segments.

In a fourth specimen from station 45 the cirri have 13–20 segments which are from half again to twice as long as broad. Small orals are present. The 10 arms are 12 mm. long. The pinnulation is complete.

Another specimen from station 45 has the cirri XIV, 12–26, 2–5 mm. long. Large and well-developed orals are present covering one-third the radius of the disk. The 10 arms are 8 mm. long. P_2 is absent. P_1 is 1.7 mm. long with 7 segments.

In a specimen from Bock's station 46 the centrodorsal is 3 mm. broad at the base and 3 mm. high. The cirri are XXII, up to 80, 45 mm. long, most of them broken or very small. From the seventh segment onward there is a dorsal crest that is gradually transformed into a dorsal spine. The radials are from two to three times as broad as long, with a small dorsal tubercle. The basals are visible in the interradial angles. The 16 arms are 70 mm. long. The brachials from about the fifty-fifth develop dorsal spines which are strongly curved and slowly increase in size. P_1 has 12 segments. P_2 is larger than P_1 and has 13 segments. P_3 has 12 segments. The distal pinnules are 10–11 mm. long with 16 segments.

A young individual from station 46 has the centrodorsal 1 mm. high. The cirri are XV, 41–46, 14–18 mm. long and resemble the apical cirri of older individuals. The radials are as long as broad, or half again as broad as long, and have a dorsal longitudinal crest. The arm bases are flattened laterally as far as the fourth brachial. The 10 arms are 25 mm. long. From the fiftieth onward the brachials develop dorsal spines. As a result of the shortness of the arms only a small part of the outer portion bears spines. The distal intersyzygial interval is 3–6 (–9) muscular articulations. P_1 is 2.5 mm. long with 8–9 segments. P_2 is 3 mm. long with 9 segments. P_3 is 2.5 mm. long with 8 segments. The distal pinnules are 5.5–6 mm. long with 15–16 segments which are two and one-half times as long as broad.

In a specimen from Bock's station 47 the cirri are XIII, 42–46, 15–23 mm. long The radials are half again as broad as long, with a dorsal crest. The 12 arms are 35 mm. long. The distal intersyzygial interval is 5–6 muscular articulations. The distal pinnules are 7 mm. long with 17 segments which are twice as long as broad.

In another specimen from station 47 the cirri are XIV, 27–34, 5–9 mm. long. The radials are half again as long as broad. There is an indistinct median crest on the elements of the IBr series. The 10 arms are 20 mm. long. P_1 is 3 mm. long with 8 segments. P_2 is 2.5 mm. long with 8 segments. The distal pinnules are 5.5 mm. long with 15 segments which are two and one-half times as long as broad.

In a third specimen from station 47 the cirri are XII, 25–36, 7 mm. long. The radials are half again as long as broad. The 10 arms are 12 mm. long. The distal intersyzygial interval is 5 muscular articulations. P_1 has 7 segments. P_2 is 2 mm. long with 8 segments. The distal pinnules are 5 mm. long with 11 segments which are from two and one-half to three times as long as broad. The orals have been resorbed.

A fourth specimen from station 47 has the cirri XIV, 12 mm. long. The radials are as long as broad. The elements of the IBr series are rather smooth. The 10 arms are 25 mm. long. P_1 is 3 mm. long with 10 segments. P_2 is 3.5 mm. long with 10 segments. P_3 is 3.5+ mm. long with 9 segments.

In another specimen from station 47 the cirri are X, 20–32, 4–10 mm. long. The radials are about as long as broad. The elements of the IBr series bear a crest with slight mediodorsal tubercles. The 10 arms are 15 mm. long. P_1 is 2 mm. long with 9 segments. P_2 is 1.8 mm. long with 9 segments, absent from some arms. P_3 is 2.5 mm. long with 8–9 segments. The distal pinnules are 4 mm. long with 12 segments which are two and one-half times as long as broad. The orals are thin, but well preserved.

In a specimen from Bock's station 53 the cirri are XXI, 69–85, 45–70 mm. long. The radials are 5 times as broad as long. The 12 arms are 90 mm. long. The brachials develop dorsal spines from the forty-fifth onward. The distal intersyzygial interval is 4–7 muscular articulations. The distal pinnules are 11.5–12.5 mm. long with 19–22 segments which are twice as long as broad.

In another specimen from station 53 the centrodorsal has an arched and rounded dorsal pole. The cirri are XVI, 62–81, 40–65 mm. long. The proximal and distal series of prominences on the cirri are not distinctly separated. The radials are 4 times as broad as long, with a dorsal spine or crest. The IIBr series are always 2. There is a pair of new regenerated arms of somewhat unequal size. The 13 arms are 80 mm. long. The brachials develop dorsal spines from about the fiftieth onward.

The distal intersyzygial interval is 6(–17) muscular articulations. P_1 is 5.5 mm. long with 11 segments. P_2 is 6 mm. long with 11 segments. P_3 is 5.5 mm. long with 12 segments. P_5 is 7 mm. long with 10 segments. P_8 is 7.5 mm. long with 13 segments. The distal pinnules are 11.5–12 mm. long with 19 segments which are from two to two and one-half times as long as broad.

Another specimen from station 53 has the cirri XVII, 65–72, 25–40 mm. long. The radials are three times as broad as long with a dorsal crest. The 12 arms are 55 mm. long. The brachials develop dorsal spines from the fiftieth onward. The distal intersyzygial interval is 4–6 muscular articulations. P_1 is 5.5 mm. long with 11–12 segments. P_2 is 6 mm. long with 11 segments. P_3 has 9 segments. The distal pinnules are 8.5–9.5 mm. long with 17 segments which are twice as long as broad.

In another specimen from station 53 the cirri are XVIII, 65–85, 36–53 mm. long. The radials are three times as broad as long with a dorsal crest. The 10 arms are 75 mm. long. The brachials develop a dorsal spine from the fiftieth onward. The distal intersyzygial interval is 5–7 muscular articulations. P_1 is 5.5 mm. long with 13 segments. P_2 is 6 mm. long with 12 segments. P_3 is 5–8 mm. long with 11 segments. P_5 is 7 mm. long with 14 segments. The distal pinnules are 11–11.5 mm. long with 18–20 segments which are from two to two and one-half times as long as broad. On one arm P_2 has grown out to a complete new arm.

Another specimen from station 53 has the centrodorsal rather low. The cirri are typical, XIV, 55–64, 30–35 mm. long. The radials are twice as broad as long with a dorsal crest. The elements of the IBr series and first two brachials have a very indistinct carination. The 11 arms are 70 mm. long. The brachials develop dorsal spines, which are rather low but increase rapidly in size in the last 10 mm., from the fiftieth brachial onward. The distal intersyzygial interval is 5–6 muscular articulations. P_1 is 5 mm. long with 13 segments. P_2 is 5.8 mm. long with 11 segments. P_3 is 5.8 mm. long with 9 segments. The distal pinnules are 11.5 mm. long with 18 segments which are two and one-half times as long as broad.

In another specimen from station 53 the cirri are XI, 60–65, 25–35 mm. long. The centrodorsal is sharply conical, 2.5 mm. high. The radials are three times as broad as long with a dorsal crest. The 11 arms are 50 mm. long, with 80–90 brachials. The brachials develop dorsal spines from the fiftieth onward. The distal intersyzygial interval is 7–8 muscular articulations. The distal pinnules are 10 mm. long with 18 segments which are twice as long as broad.

Another specimen from station 53 has the cirri XVI, 50–60, 20–30 mm. long. The 10 arms are 45 mm. long and are composed of 70–75 brachials which develop a dorsal spine from about the fortieth. The distal intersyzygial interval is 5–7 muscular articulations. P_1 is 3.5 mm. long with 9 segments. P_2 is 3.8 mm. long with 10 segments. P_3 is 3.5 mm. long with 9 segments. The distal pinnules are 9 mm. long with 18 segments.

A young specimen from station 53 has the cirri XI, 20–21, 2.5–3 mm. long. The first cirrus segment is short, the second is somewhat longer than broad, the third is two and one-half times as long as broad, the fourth and fifth are twice as long as broad, the sixth is half again as long as broad, distally broadened, and the seventh and following are as long as broad with an inconspicuous dorsal carination which is transformed distally into a dorsal spine. The opposing spine rises to a height equal to half that of the penultimate segment. The terminal claw is about as long as the penultimate segment. The basals form a narrow continuous ring, especially projecting at the interradial angles. The radials are half again as broad as long with a strong longitudinal crest in the proximal two-thirds. They are laterally contiguous and enclose practically the whole intestinal sac. The IBr_1 have a mediodorsal crest like the IBr_2 (axillaries) and are well separated from each other laterally. The 10 arms are 7 mm. long with only 13–18 brachials. On the two arms of a single postradial series syzygies occur between brachials 3+4 and 10+11. The disk is concealed. P_1 to P_3 are usually absent. Sometimes, however, P_1 and P_3 are developed. The distal pinnules are 3 mm. long with 14 segments. Because of the relatively great size of the pinnules the brachials, especially the eighth and eleventh, appear almost like axillaries.

In another young specimen from station 53 the cirri are XIV, 20–35, 7–10 mm. long. The 10 arms are 15 mm. long. The distal pinnules are 5.5 mm. long with 15 segments which are three times as long as broad. Rudimentary orals are present.

Another young specimen from station 53 has the cirri XI, 25–35, 8–13 mm. long. The 10 arms are 15 mm. long. The distal pinnules are 5.5 mm. long with 15 segments which are two and one-half times as long as broad.

The last specimen from station 53 has the cirri XIII, 17–31, 3–11 mm. long. The 10 arms are 15 mm. long. The distal pinnules are 5 mm. long with 15 segments which are two and one-half times as long as broad.

In a specimen from Bock's station 54 the cirri are XVI, (14)–27, (3)–7 mm. long. The fourth cirrus segment is the longest, three times as long as broad. Dorsal spines are developed from the sixth (to tenth) segment onward. The radials are half again as long as broad with a well circumscribed median tubercle. The elements of the IBr series are similar, but with a median keel, the IBr_1 being half again as broad as long and the IBr_2 (axillaries) as long as broad. The IBr_1 and the first brachials have a slight lateral carination. The 10 arms are 8 mm. long. There is a median keel on the first two brachials, less developed than that on the IBr series. P_1 is 2.2 mm. long with 9 segments. P_2 is lacking. Small orals are present.

In another specimen from station 54 the cirri are XV, 10–16 mm. long. The radials are as long as broad. The elements of the IBr series have a rather distinct median crest. The 10 arms are 25 mm. long. The distal pinnules are 6.5 mm. long; their segments are twice as long as broad.

In a specimen from Bock's station 55 the cirri are XI, 16–22, 4–5 mm. long; the third-sixth segments are the longest, two and one-half times as long as broad, and the distal segments are half again as long as broad. There is a dorsal carination from the ninth segment onward. The opposing spine rises to a height equal to half the width of the penultimate segment. The basals form a narrow continuous ring especially projecting in the interradial angles. The radials are twice as broad as long with a high keel, interradially somewhat produced anteriorly, extending distally between the IBr_1. The 10 arms are 7 mm. long. The outermost brachials have a small dorsal spine. The brachials bearing pinnules usually are shaped like axillaries. The lowest pinnule is most often on the seventh brachial. There is sometimes also a small P_1. One axillary bears on the left a long arm, 5 mm. long, provided with a small P_1 and distal pinnules, and on the right a smaller arm, 2 mm. long, without pinnules. On the remaining postradial series the right arms are usually a little shorter than the left. On one postradial series both arms have 15 brachials; one has syzygies between brachials 3+4 and 12+13, the other only a single syzygy, between brachials 3+4. P_3 is 2 mm. long with 12 segments.

In a specimen from Bock's station 56 the centrodorsal is sharply conical, 3 mm. broad at the base and 3 mm. high, with the dorsal pole smooth and arched and somewhat hollowed at the summit. The cirrus sockets are arranged in 10 columns which are separated by midradial interspaces. The cirri are XVII, 80-81, 50–55 mm. long. The first and second segments are short, those following increasing to about as long as broad or a little longer on the fifth-twentieth segments, then decreasing so that those from about the fortieth onward are about twice as broad as long. Usually the segments from the third (or fifth) to about the fifteenth have a dorsal crest which is most marked on the proximal segments. The fifteenth–twenty-fifth segments are most often more or less smooth, then a dorsal carination appears which distally becomes accentuated into a dorsal spine. The opposing spine is larger than the spines on the segments preceding, rising to a height equal to half the width of the penultimate segment. From three to five of the terminal segments have very slight dorsal spines, or even lack them entirely. The terminal claw is short, equal in length to the penultimate segment. The radials are four times as broad as long, with a median tubercle. The IBr_1 are two and one-half times as long as broad, and are laterally united basally. The IBr_2 (axillaries) are low pentagonal and, like the IBr_1, have an indistinct median longitudinal crest. The IIBr series are 2, resembling the IBr series. The 16 arms are 65 mm. long. The first brachials are interiorly united. The arms are sharply flattened laterally as far as about the tenth brachial. After the tenth the brachials become decidedly triangular. From the fortieth to the fiftieth onward the brachials have a median distally directed spine. The last ten brachials have only rudimentary pinnules. On two sample arms syzygies occur between brachials 3+4, 12+13, 22+23, 30+31, 37+38; and brachials 3+4, 13+14, 21+22, 28+29, 35+36, 41+42, 48+49, 55+56. In a single case the first two syzygies are between brachials 4+5 and 13+14. The distal intersyzygial interval is 6–9 muscular articulations. P_1 is 5 mm. long, smooth and prismatic, with 12 segments of which the first is broader than long and those following are from half again to twice as long as broad. P_2 is 5.5 mm. long with 12 segments. P_3 is 6 mm. long with 12 segments. P_{10} is 8 mm. long with 15 segments. The distal pinnules are 10 mm. long with 18 segments which are twice as long as broad. The disk is 8.5 mm. in diameter. The color in alcohol is yellow-brown, in life probably flame-color as the alcohol and still more the formalin in which the other specimens are preserved is stained bright red.

In another specimen from station 56 the centrodorsal is 4 mm. broad at the base and 4 mm. high; the dorsal depression is only slightly developed. The cirri are XX, 85–90, 60–70 mm. long. There is no distinct dorsal spine on the cirri before the twentieth or twenty-fifth segment. The sixth-twelfth segments have a slightly indicated dorsal crest. The 12 arms are 90–100 mm. long. On a sample postradial series with three arms the syzygies are distributed as follows. On the undivided arm, between brachials 3+4, 10+11, 17+18, 25+26, 32+33, 38+39, 43+44, 48+49. On the inner arm from the IIBr axillary, between brachials 1+2, 3+4, 9+10, 15+16, 20+21, 28+29, 34+35, 40+41, 45+46; on the outer arm from the IIBr axillary, between brachials 3+4, 7+8, 9+10, 13+14, 20+21, 27+28, 33+34, 39+40. The distal intersyzygial interval is 4–7 muscular articulations. P_1 is 6 mm. long with 13 segments. P_2 is 7 mm. long with 13 segments. P_3 is 6.5 mm. long with 13 segments. The distal pinnules are 11 mm. long with 17–19 segments.

In another specimen from station 56 the centrodorsal has no dorsal depression. The cirri are XX, 71–86, 40–56 mm. long. There is a dorsal crest on most of the segments from the fourth or fifth onward. There is no gap between this crest and the dorsal spines, which begin on about the fifteenth segment. The 11 arms are 80 mm. long; they are laterally flattened as far as the fourth brachial. The brachials develop a dorsal spine from about the sixtieth; the terminal eight have only rudimentary pinnules. The distal intersyzygial interval is 4–6 muscular articulations. P_1 is 5.5 mm. long with 12 segments. P_2 is 5.5 mm. long with 9 segments. P_3 is 6 mm. long with 9 segments. The distal pinnules are 11.5 mm. long with 18–19 segments.

In another specimen from station 56 the centrodorsal is lower than in that preceding, not conical at the apex, 2.5 mm. broad at the base and 1.5 mm. high. There is no dorsal depression. The cirri are XVI, 69–76, 40–55 mm. long. The third-fifth segments have a dorsal spine, those following a crest, becoming smooth on about the fifteenth, then gradually developing dorsal spines distally. The radials have a slight median tubercle. The 10 arms are 70 mm. long. Dorsal spines are developed from the fortieth brachial onward. The distal intersyzygial interval is 6–11 muscular articulations. P_1 is 4 mm. long with 8 segments. P_2 is 5 mm. long with 10 segments. P_3 is 5 mm. long with 10 segments. The distal pinnules are 10 mm. long with 16 segments.

Another specimen from station 56 has the centrodorsal as in the preceding. The cirri are XVI, 59–82, 26–54 mm. long. The radials have a very high and well-marked tubercle. The IBr_1 have a trace of a crest. The 10 arms are 80 mm. long. The brachials from about the twentieth onward have dorsal spines. The terminal 7 have only rudimentary pinnules. The distal intersyzygial interval is 6–8 muscular articulations. P_1 is 5 mm. long. P_2 is 5.5 mm. long. P_3 is 5 mm. long. The distal pinnules are 10 mm. long with 19 segments.

In another specimen from station 56 the cirri are XVI, 57–68, 35–48 mm. long. The third-fifth segments have a small dorsal spine, and the sixth-tenth (or fifteenth) are smooth. The radials carry a very small tubercle. The 12 arms are 55 mm. long. The brachials develop dorsal spines from the fortieth onward. The distal intersyzygial interval is 6–9 muscular articulations. P_1 is 4.5 mm. long with 9 segments. P_2 is 5.5 mm. long with 9 segments. P_3 is 6 mm. long with 7 segments. The distal pinnules are 8 mm. long with 15 segments.

In a rather small specimen from station 56 the cirri are XIII, 39–62, 14–29 mm. long. The cirrus segments are longer than those of the preceding specimen. The second-sixth segments have both a ventral and a dorsal crest, and the seventh-tenth (or twelfth) are smooth. The radials have a high median prominence. The elements of the IBr series are almost smooth. The 10 arms are 35 mm. long. The brachials develop a dorsal spine from the thirty-fifth onward. The terminal two to four brachials have rudimentary pinnules. On one arm syzygies occur between brachials 3+4, 14+15, 22+23, and 31+32. P_1 is 3.5 mm. long with 9 segments. P_2 is 4 mm. long with 9 segments. P_3 is 4 mm. long with 10 segments. The distal pinnules are 7 mm. long with 16 segments.

In a specimen from Bock's station 57 the cirri are XV, 17–32, 4–10 mm. long. The radials are as long as broad. The elements of the IBr series are rather smooth. The 10 arms are 12 mm. long. P_1 is 2.5 mm. long with 8 segments. P_2 is absent. P_3 is 2.8 mm. long with 10 segments. The distal pinnules are 4 mm. long with 14 segments which are twice as long as broad. The disk is 1.8 mm. in diameter. The orals have been resorbed.

In a specimen from Boċk's station 59 the centrodorsal is sharply conical, 3 mm. high. The cirri are XVII, 77–90, 45–65 mm. long. From the third to the seventh (or fifteenth) the cirrus segments bear a dorsal spine; after these there are usually some smooth segments. The ninth-twenty-fifth segments are longer than broad. All the distal segments have dorsal spines. The opposing spine is usually not longer than the spines on the segments preceding. The radials are three times as broad as long. The 10 arms are 95 mm. long, they are laterally flattened as far as the eighth brachials. The dorsal spine is developed from the sixtieth brachial onward. The distal intersyzygial interval is 4–6 muscular articulations. P_1 is 7 mm. long with 12 segments. P_2 is 8 mm. long with 12 segments. P_3 is 7.5 mm. long with 9 segments. The distal pinnules are 11 mm. long with 16 segments. The color in alcohol is red-brown.

In a specimen from Bock's station 59 the cirri are XIX, 56–75, 40–50 mm. long. More often than in the specimen just preceding there are weak spines before the opposing spine. The radials are three times as broad as long, with a dorsal crest. The 11 arms are 75 mm. long. The brachials from the fiftieth to sixtieth onward develop a dorsal spine that rises to a height of one-third the width of the brachial. The distal intersyzygial interval is 6–7 muscular articulations. P_1 is 5.5 mm. long with 12 segments. P_2 is 6.5 mm. long with 11 segments. P_3 is 5 mm. long with 7–9 segments. The distal pinnules are 11 mm. long with 18 segments which are two and one-half times as long as broad.

In another specimen from station 59 the centrodorsal is 2.5 mm. high. The cirri are XVII, 65–85, 45–60 mm. long. There is no dorsal spine before the twentieth (or twenty-fifth) cirrus segment. The 11 arms are 85 mm. long. The brachials from about the sixty-fifth onward develop dorsal spines that rise to a height of about one-fifth the width of the brachial. The distal intersyzygial interval is 4–6 muscular articulations. P_1 is 6.5 mm. long with 14 segments. P_2 is 8.5 mm. long with 14 segments. P_3 is 8 mm. long with 13 segments. The distal pinnules are 12.5 mm. long with 22 segments.

Another specimen from station 59 has the cirri XVIII, 65–85, 40–65 mm. long. The radials are two and one-half times as broad as long. The 10 arms are 85 mm. long. From about the fiftieth brachial onward dorsal spines are developed which resemble those of the specimen preceding. The distal intersyzygial interval is 5–10 muscular articulations. P_1 is 5.5 mm. long with 11 segments. P_2 is 6 mm. long with 11 segments. P_3 is 6 mm. long with 11 segments. The distal pinnules are 13 mm. long with 20 segments.

In another specimen from station 59 the centrodorsal is rather bluntly conical, 2 mm. high. The cirri are XX, 65–80, 40–55 mm. long. The radials have a very slight dorsal tubercle. The 10 arms are 95 mm. long. The proximal brachials are somewhat tubercular. Dorsal spines are developed from the fiftieth or sixtieth brachials onward. The distal intersyzygial interval is 6–11 muscular articulations. P_1 is 6.5 mm. long with 12 segments. P_2 is 7.5 mm. long with 12 segments. P_3 is 7 mm. long with 11 segments. The distal pinnules are 13.5 mm. long with 22 segments.

Another specimen from station 59 has the centrodorsal 3 mm. high. The cirri are XXI, 55+, 35+ mm. long. The radials are four times as broad as long and have a slight dorsal tubercle. There are 13 arms, all of which are broken. In one case the first syzygy is between brachials 1+2. P_1 is 5 mm. long with 10 segments (or 8 if on an arm following a IIBr axillary). P_2 is 6 mm. long with 9–10 segments. P_3 is 5.5 mm. long with 8 segments.

From station 59 another specimen has the centrodorsal sharply conical, 2.8 mm. high. The cirri are XX, 60–70, 30–55 mm. long. The proximal row of prominences on the cirri is indistinctly separated from the distal. The radials are three times as broad as long with a dorsal tubercle which is indistinctly delimited distally. The 10 arms are 85 mm. long. The brachials develop dorsal spines from the fiftieth onward. The distal intersyzygial interval is 4–5 muscular articulations. P_1 is 6.5 mm. long with 11 segments. P_2 is 9 mm. long with 13 segments. P_3 is 8 mm. long with 11 segments. P_4 is 6 mm. long with 10 segments. P_5 is 7.5 mm. long with 14 segments. The distal pinnules are 12.5 mm. long with 21 segments of which the longest are at least three times as long as broad. The disk is 6 mm. in diameter.

In another specimen from station 59 the cirri are XVIII, 50–65, 30–50 mm. long. The radials are four times as broad as long with a dorsal crest. The 11 arms are 70 mm. long. Dorsal spines are developed from about the fortieth brachial. The distal intersyzygial interval is 6–9 muscular articulations. P_1 is 6 mm. long with 11 segments. P_2 is 6.5 mm. long with 11 segments. P_3 is 6.5 mm. long with 9–10 segments. P_4 is 6 mm. long with 11 segments. The distal pinnules are 11 mm. long with 18 segments which are from two and one-half to three and one-half times as long as broad.

Another specimen from station 59 has the centrodorsal bluntly conical, 3 mm. high. There are XXII cirri. The radials are five times as broad as long with a dorsal tubercle. There are 11 arms 95 mm. long. From the sixtieth onward the brachials develop a dorsal spine that rises to a height equal to one-third the width of the brachial. The distal intersyzygial interval is 4–7 muscular articulations. P_1 is 7 mm. long with 12 segments. P_2 is 9 mm. long with 13 segments. P_3 is 7 mm. long with 11 segments. P_4 is 8.5 mm. long with 13 segments. The distal pinnules are 10+ mm. long composed of segments from twice to two and one-half times as long as broad.

In a specimen from station 59 the cirri are XX, 61–82, 40–65 mm. long. The radials are four times as broad as long with a dorsal tubercle. The 10 arms are 85 mm. long. The brachials develop dorsal tubercles from the fiftieth onward. The distal intersyzygial interval is 4–6 muscular articulations. P_2 is 7 mm. long with 12 segments. P_3 is 7 mm. long with 10+ segments. The distal pinnules are 11.5–13.5 mm. long with 17–20 segments which are from two and one-half to three times as long as broad.

A specimen from station 59 has the centrodorsal bluntly dome-shaped, 4.5 mm.

high. The cirrus sockets are arranged in five groups, 3–5 in each group. The cirri are XX, all lost. The radials are five times as broad as long. The 12 arms are 100 mm. long; they are sharply flattened laterally as far as the fourth brachial. The brachials develop a dorsal spine from about the fifty-fifth onward. One postradial series bears two IIBr 2 series. The distal intersyzygial interval is 6–7 muscular articulations. P_1 is 7 mm. long with 13 segments. P_2 is 9.5 mm. long with 14 segments. P_3 is 8 mm. long with 12 segments. The distal pinnules are 12+ mm. long.

In a specimen from station 59 the centrodorsal is a pointed cone. The cirri are XVII, 65–83, 38–68 mm. long. The radials are three times as broad as long with a dorsal crest. The 10 arms are 85 mm. long. The brachials develop a dorsal spine from about the fifty-fifth. The distal intersyzygial interval is (3–)5–6 muscular articulations. The distal pinnules are 11.5 mm. long with 19 segments which are two and one-half times as long as broad.

A specimen from station 59 has the centrodorsal 3.5 mm. high. The cirri are XXII, 72–82, 55–73 mm. long. The radials are from three to four times as broad as long, with a dorsal crest. The 10 arms are 105 mm. long. The brachials develop a dorsal spine from the fifty-fifth onward. The distal intersyzygial interval is 6 muscular articulations. The distal pinnules are 15 mm. long with 22 segments which are from two and one-half to three times as long as broad.

A specimen from station 59 has the cirri XIX, 75–86, 38–63 mm. long. The 10 arms are 85 mm. long. The brachials develop a dorsal spine, which increases slowly in height, from about the fortieth. The distal intersyzygial interval is 5–6 muscular articulations. The distal pinnules are 11 mm. long with 17 segments which are two and one-half times as long as broad.

In another specimen from station 59 the centrodorsal is sharply conical, 2.5 mm. high. The cirri are XXI, 55–75, 30–57 mm. long. The radials are four times as broad as long, with a dorsal tubercle. The 10 arms are 75 mm. long. The dorsal spines first appear at about the seventy-fifth brachial, and are rather low. The distal intersyzygial interval is 6–7(–17) muscular articulations. P_1 is 5 mm. long with 10 segments. P_2 is 5.5 mm. long with 12 segments. P_3 is 6 mm. long with 10 segments. P_4 is 6.5 mm. long with 12 segments. The distal pinnules are 11 mm. long with 20 segments which are from twice to two and one-half times as long as broad.

Other specimens from station 59 have the following characters: The cirri are XVIII, 56–76, 32–57 mm. long. The radials are three times as broad as long, with a slight tubercle. The 11 arms are 65 mm. long. The brachials develop a dorsal spine on the fiftieth. The distal intersyzygial interval is 4–6 muscular articulations. P_1 is 5 mm. long. P_2 is 5.7 mm. long with 11 segments. P_3 is 6 mm. long with 10 segments. The distal pinnules are 10.5 mm. long with 19 segments which are twice as long as broad. The centrodorsal is cylindrical, 3 mm. high, with the dorsal pole rounded and showing a small depression. The cirri are XXIII, 68–77, 45–60 mm. long. The radials are six times as broad as long with a dorsal crest. There is a slight carination on the ossicles of the IBr series. The 10 arms are 70 mm. long. The dorsal spines on the brachials, which are rather weak, are developed from about the fiftieth onward. The distal intersyzygial interval is 5–7 muscular articulations. The distal pinnules are about 10 mm. long composed of segments which are twice as long as broad. The cirri are XVIII, 70–100, 55–70 mm. long. The radials are four times as broad as long with a dorsal tubercle. The IBr_1 is smooth. There are 10 arms, all broken. P_1 is 6 mm. long with 9 segments. P_2 is 7.5 mm. long with 11 segments. P_3 is 7 mm. long with 9 segments. The centrodorsal is a rather low pointed cone 2 mm. high. The cirri are XV, 56–70, 25–47 mm. long. The short apical cirri have the seventh-fourteenth segments slender, twice as long as broad. The radials are three times as broad as long with a dorsal crest. The 10 arms are about 60 mm. long. The brachials develop dorsal spines from the fiftieth onward. The distal intersyzygial interval is 5–6 muscular articulations. P_1 is 5.5 mm. long with 10 segments. The distal pinnules are 9.5 mm. long with 18 segments which are from two to two and one-half times as long as broad. The centrodorsal is 3.5 mm. high. The cirri are XVII, 67–82, 48–62 mm. long. The radials are three times as broad as long, with a dorsal crest. The 11 arms are 85 mm. long. Dorsal spines are developed from the fiftieth brachial onward. The distal intersyzygial interval is 6–9 muscular articulations. P_1 is 5.5 mm. long with 11 segments. P_2 is 7 mm. long with 12 segments. P_3 is 6.2 mm. long with 9 segments. The distal pinnules are 10 mm. long with 18 segments which are from two to two and one-half times as long as broad.

In the specimen from the Sahul Bank, which was described as a new species under the name of *Asterometra acerba*, the cirri are XX, 84–90, 55 mm. long, more slender than those of the type specimen of *A. anthus*. The radials have a moderately prominent dorsoventrally elongated median tubercle. The elements of the IBr series have a faint narrow low median carination. The 10 arms are 80 mm. long, slightly more slender than those of the type specimen of *A. anthus*, with slightly longer brachials. The arms are distally strongly compressed laterally, but the overlapping dorsal spines are not nearly so long or so stout as in the type of *A. anthus*. The pinnules are much longer than those of the type of *A. anthus* and more slender, with proportionately longer segments which terminally are three times as long as broad or even longer; in the type of *A. anthus* the length does not exceed twice the width. P_1 is 7 mm. long with 12 segments. P_2 is similar, 7.5 mm. long. P_3 is 8 mm. long, slightly stouter than P_2. P_5 is 9 mm. long. The distal pinnules are 13 mm. long.

Gislén noted that the carinate process on the radials is more distinct in young than in full-grown individuals because in them the radials are longer. With increasing age the radials become more and more concealed by the centrodorsal, and are also shortened by the rapid increase in width. Correlatively, the carinate process grows smaller and finally remains only as a rounded tubercle. He said that in the very young specimens examined by him one can plainly follow the shortening of all the ossicles during growth already observed by P. H. Carpenter. Perhaps this is best shown in the proportions of the cirrus segments, but it is also well seen in the radials and proximal brachials. In the brachials also one can follow the disappearance of the juvenile carination on the first two, and the appearance of certain indications of old age, such as the indistinct carination on the same ossicles in certain old specimens. The pinnule segments seem to be but slightly affected.

The occurrence of orals is also very interesting. In specimens with an arm length of less than 10 mm. they are well preserved, but they usually begin to be resorbed at an arm length of 10–12 mm. and are completely lost when the arm length reaches 15 mm.—that is, at about the time the pinnulation is complete.

The smallest specimens also have large basals that form a continuous ring visible under the radial circlet. In the smallest specimens the radial circlet encloses the whole visceral mass.

All these primitive characters therefore persist rather late in this species.

Gislén found the number of arms in 36 nearly full grown individuals to be as follows: 10 (18 specimens), 11 (9), 12 (5), 13 (2), and 16 (2). He remarked it is rather curious that the largest specimens often have only 10 arms while the multibrachiate specimens have shorter arms. He said that a similar condition is also noticed in *Cyllometra pulchella* (=*manca*, see page 137) and perhaps has something to do with the catching of food (see Part 2, page 84, fourth paragraph). He noted that the length of the distal pinnules, with some irregularities, follows the length of the arms: but it shows great variability in specimens with an arm length of 70–90 mm.

On the basis of his abundant material Professor Gislén discussed the status of *Asterometra lepida* and *A. acerba,* each described from a single specimen. He said that *A. lepida* is supposed to differ from *A. anthus* and *A. acerba* by having a small conical centrodorsal with smaller cirrus sockets and therefore presumably more slender cirri. He noted it is a general rule that the apical cirri, formed at a younger stage, are more slender than the proximal cirri, formed at an older stage. The more robust the individual is the more robust are the cirri. This character is therefore not necessarily very important if other features supporting the suggestion of a real difference are not added. The form of the centrodorsal is subject to great variation. A specimen from Bock's station 53 with an arm length of 70 mm., and therefore of the same size as the type specimen of *A. lepida,* has a small conical centrodorsal with relatively small cirrus sockets. A specimen from station 59 with an arm length of 85 mm. is transitional to another from station 59 with an arm length of 100 mm. the centrodorsal of which is of the typical *anthus-acerba* form. As all transitions between the type of centrodorsal found in the single specimen of *A. lepida* and the form typical of *A. anthus* occur Gislén said he could not consider *A. lepida* as anything but a young individual of *A. anthus.* With this conclusion I agree.

Regarding the supposed differences between *A. anthus* and *A. acerba* Gislén said that I differentiated the two by the following characters; in *A. anthus* (A) the distal pinnules are 9 mm. long, (B) the outer segments of the distal pinnules are twice as long as broad, (C) the dorsal brachial spines are long and strongly curved, (D) the radials have a rounded tubercle, (E) the IBr series lack a median keel, and (F) the arms are more than 10; whereas in *A. acerba* (a) the distal pinnules are 13 mm. long, (b) the outer segments of the distal pinnules are up to three times as long as broad, (c) the dorsal brachial spines are blunt, short, and not much curved, (d) the radials have a dorsoventrally elongated tubercle, (e) the IBr series have a faint, low, median carination, and (f) there are 10 arms.

In some of his specimens he found these characters mixed in the following manner; in a specimen from Bock's station 56, A(a), B, c, D, E, F; in six specimens from station 59, Aa, Bb, C, d, E, F; A(a), B, c, d, e, (F)f; a, (B)b, C, D, E, f; a, b, C, D, E, f; Aa, b, C, d, E, F; a, b, C, d, E, f; and in a specimen from station 53, (A)a, Bb, Cc, d, e, F.

From these examples, he said, it seemed evident that the characteristics of *A. anthus* and *A. acerba* are irregularly mixed in the different individuals. He noted that

I laid special stress upon the fact that the length of the distal pinnules and of their component segments are characteristic of *A. acerba.* He remarked that this combination scarcely ever occurs in his specimens, though often long pinnule segments together with strongly developed brachial spines. He concludes that *acerba* is a synonym of *anthus.*

Gislén said that the only tolerably sure difference between *Asterometra anthus* and *A. macropoda* seems to be the appearance, length, and number of segments of the cirri, young specimens of *A. macropoda* being, in fact, very difficult or even impossible to distinguish from the young of *A. anthus.*

The proximal dorsal spines of the cirri are usually more strongly developed in specimens of *A. anthus* from the Bonin Islands than in those from Japan.

Parasite.—Professor Gislén noted that specimens from Bock's stations 51, 53, 54, and 56 carried parasitic gastropods of the genus *Stylina* (see Part 2, page 648).

Localities.—Dr. Th. Mortensen's Pacific Expedition 1914–'16, station 9; the coral bank, Goto Islands, off southwestern Japan (lat. 32°15′ N., long. 128°12′ E.); 162 meters; hard bottom; May 15, 1914 [Gislén, 1927].

South of the Goto Islands (lat. 32°15′ N., long. 128°20′ E.); 183 meters; Capt. H. Christiansen, April 17, 1926 (1, C. M.).

Albatross station 4936; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 21° E., 5.7 miles distant (lat. 30°54′40″ N., long. 130°37′30″ E.); 185 meters; bottom temperature 15.89° C.; stones; August 16, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1915, 1918] (1, U.S.N.M., 22625).

Formosa (Taiwan) Strait; 64 meters [A. H. Clark, 1908, 1909, 1912, 1913, 1915, 1918; Gislén, 1922; Sieverts, 1932] (1, C. M.).

Dr. Sixten Bock's Expedition to Japan station 45; Bonin Islands, east of Chichijima; 146 meters; July 31, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 46; Bonin Islands, east of the Channel; 128 meters; August 1, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 47; Bonin Islands, east of the Channel; 146 meters; August 1, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 53; Bonin Islands, 2 miles east of Higashijima; 165 meters; sand and broken shells; August 7, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 54; Bonin Islands, east of Chichijima; 128 meters; broken shells and sand; August 7, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 55; Bonin Islands; eastnortheast of Chichijima; 210 meters; sand and shells; August 15, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan, station 56; Bonin Islands, east of the Channel; 210 meters; August 15, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 57; Bonin Islands, east of Chichijima; 183 meters; August 15, 1914 [Gislén, 1922, 1924].

Dr. Sixten Bock's Expedition to Japan station 59; Bonin Islands, eastnortheast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922, 1924].

Sahul Bank (lat. 10°30′ S., long. 125° E.); from a cable [Bell, 1893; A. H. Clark, 1909, 1912; Gislén, 1922] (1, I. M.).

Geographical range.—From the Bonin Islands, southwestern Japan, and Formosa

(Taiwan) southward to the Sahul Bank, south of western Timor.

Bathymetrical range.—From 64 to 185 (?210) meters. The depth records from Dr. Bock's stations represent the length of line out, not the actual depth.

History.—In 1893 Prof. F. Jeffrey Bell recorded some specimens from the Sahul Bank under the name of *Antedon longicirra* one of which represented this species.

The species was originally described as *Antedon anthus* in 1907 from a specimen from *Albatross* station 4936 off southwestern Japan. Later in the same year it was assigned to the new genus *Ptilometra*, and in 1908 it was placed in the genus *Asterometra.*

In 1908 I described *Asterometra lepida* from a specimen from the Straits of Formosa in 35 fathoms in the Copenhagen Museum, and in 1909 I described *Asterometra acerba* from a specimen from the Sahul Bank south of Timor that had previously been recorded by Bell under the name of *Antedon longicirra.*

In 1922 Prof. Torsten Gislén recorded and gave notes on 54 specimens from the Bonin Islands that had been collected by Dr. Sixten Bock during the course of his expedition to Japan in 1914, and at the same time discussed the species in great detail. Under *Asterometra anthus* he placed as synonyms my *Asterometra lepida* and *A. acerba.* In 1927 Professor Gislén recorded and gave notes on 14 specimens that had been collected by Dr. Th. Mortensen off southwestern Japan in 1914 and further discussed the species.

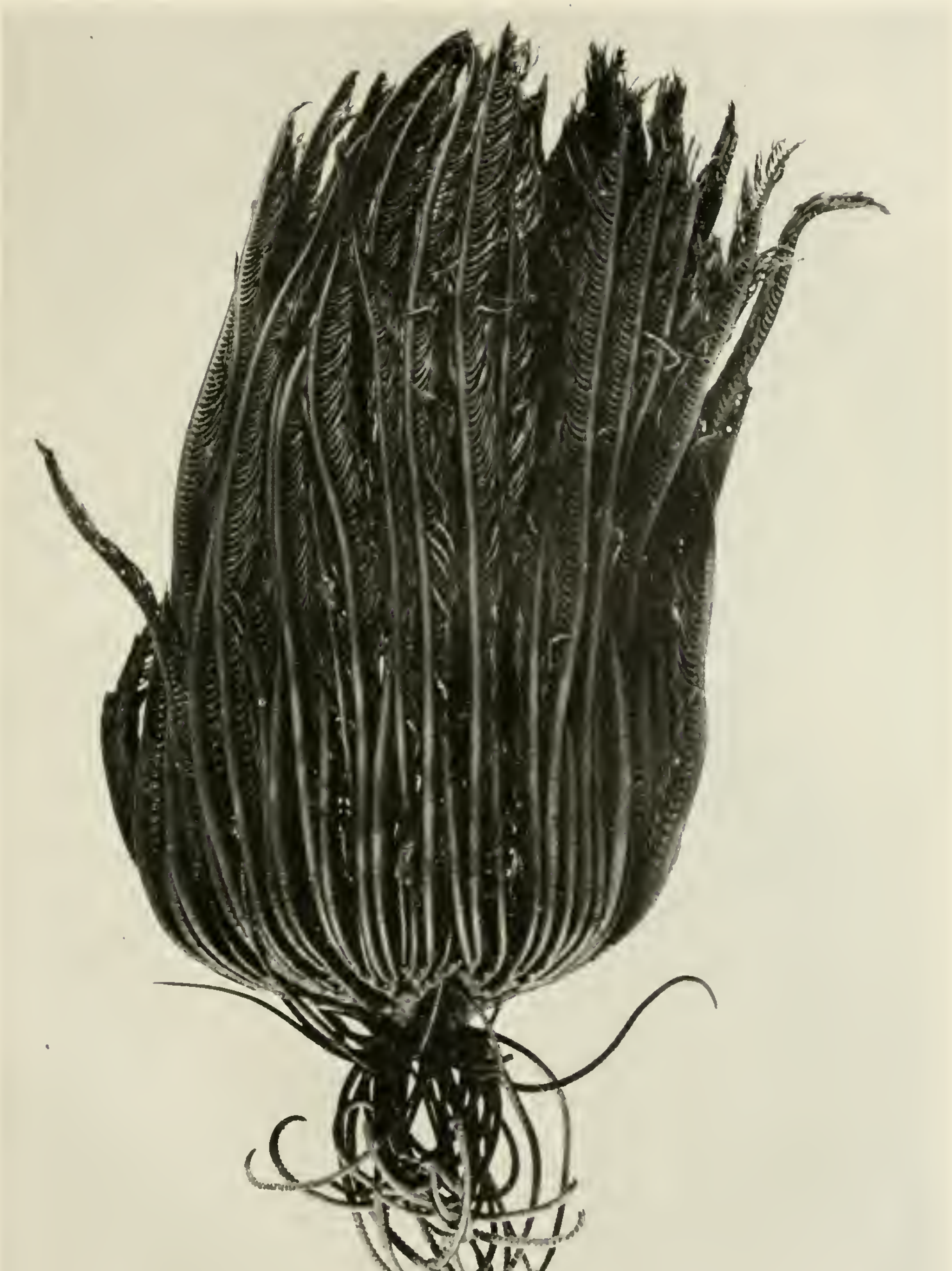
ASTEROMETRA sp.

Asterometra sp., juv., Gislén, Vid. Medd. Dansk Naturh. Foren., vol. 83, 1927, p. 43 (Mortensen's station 9; notes), p. 68 (listed).

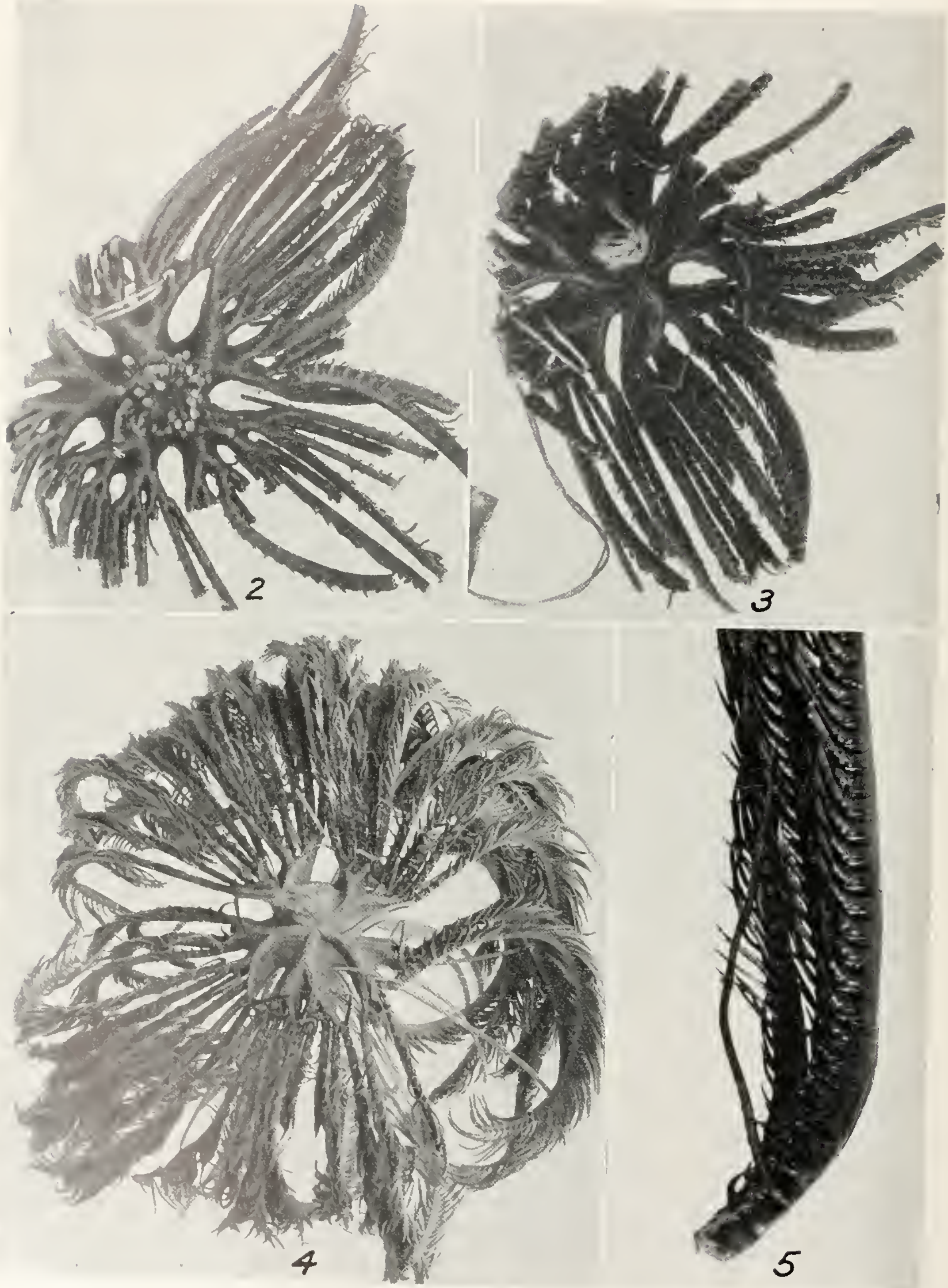
Locality.—Dr. Th. Mortensen's Pacific Expedition 1914–'16, station 9; the coral bank, Goto Islands, off southwestern Japan (lat. 32°15′ N., long. 128°12′ E.); 162 meters; hard bottom; May 15, 1914 [Gislén, 1927].

Remarks.—Professor Gislén recorded from Mortensen's station 9 three undetermined specimens with the following characters. (1) The cirri are XIII, 37–51, 17–28 mm. long; the 10 arms are 27 mm. long; the radials are half again as broad as long and, like the ossicles of the IBr series, have a middorsal carination; P_1 is 2.3 mm. long with 8 segments; P_2 is 2.9 mm. long with 7 segments; P_3 is 2.8 mm. long with 6 segments. (2) The cirri have 36–42 segments and are 14–20 mm. long; the 10 arms are 27 mm. long; the ossicles of the IBr series are carinate. (3) The cirri are 19+ mm. long; the 10 arms are 20+ mm. long; P_1 is 2.5 mm. long with 9 segments.

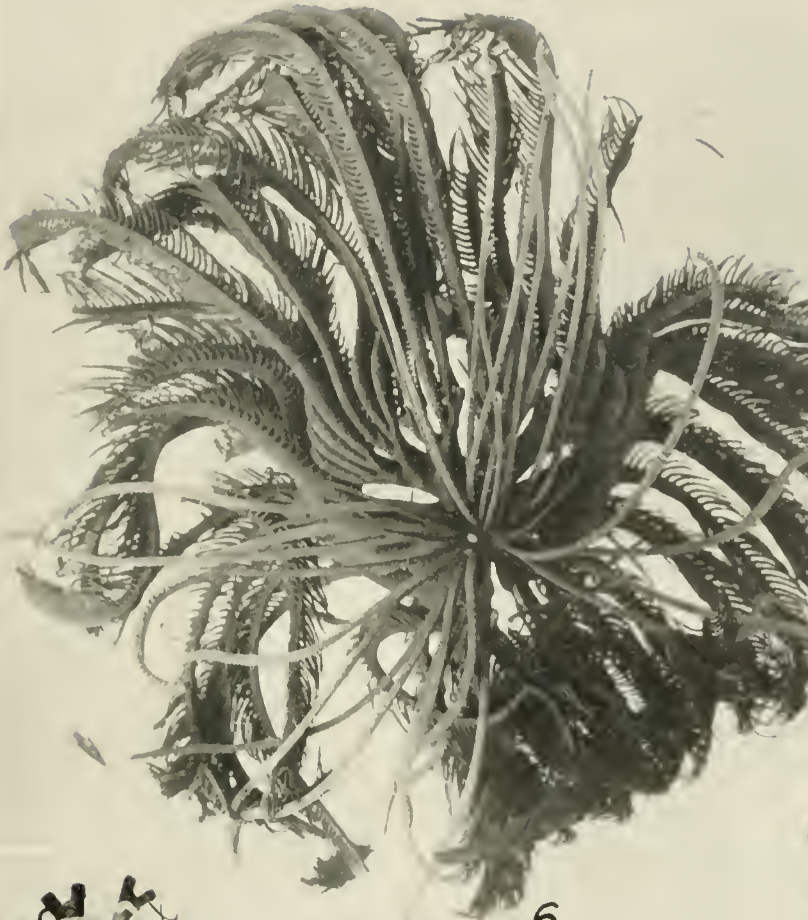
Professor Gislén said that usually the tubercle on the dorsal side of the radials is developed in *Asterometra anthus*, but in some cases it may be lacking. None of the specimens of *A. anthus* show carination of the ossicles of the IBr series. The five tubercles on the dorsal pole of the centrodorsal which he in his memoir of 1922 considered as distinctive of *A. macropoda* do also sometimes occur in the specimens of *A. anthus* from Mortensen's station 9, and may be lacking in specimens of *A. macropoda.*



1, *Pontiometra andersoni* from *Albatross* station 5146 (U.S.N.M., 35222).

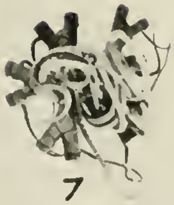


2–5, *Pontiometra andersoni:* 2, 3, The type specimen from King Island, Mergui Archipelago (I.M.); 4, specimen from Singapore (C.M.); 5, proximal pinnules of the specimen from *Albatross* station 5146, shown on pl. 1 (U.S.N.M., 35222).

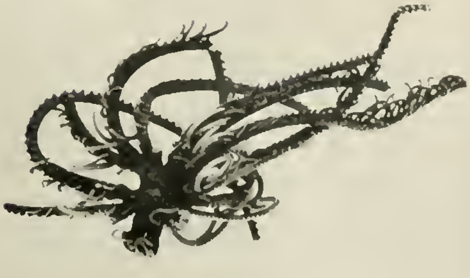


6

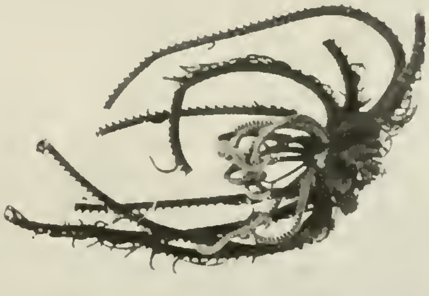
8



7



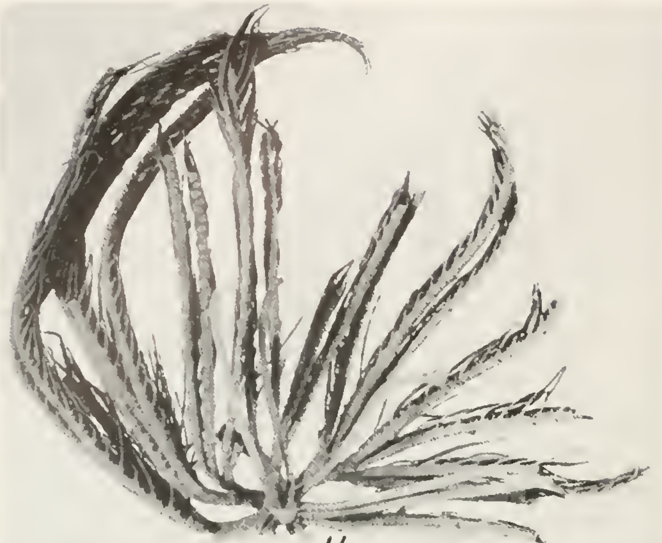
9



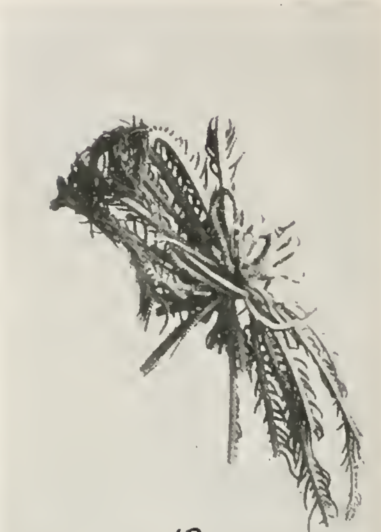
10

6–8, *Pontiometra andersoni:* 6, Specimen from Singapore (C.M.); 7, 8, the type specimen of *Pontiometra insperatus*, from *Albatross* station 5145 (U.S.N.M., 35468).

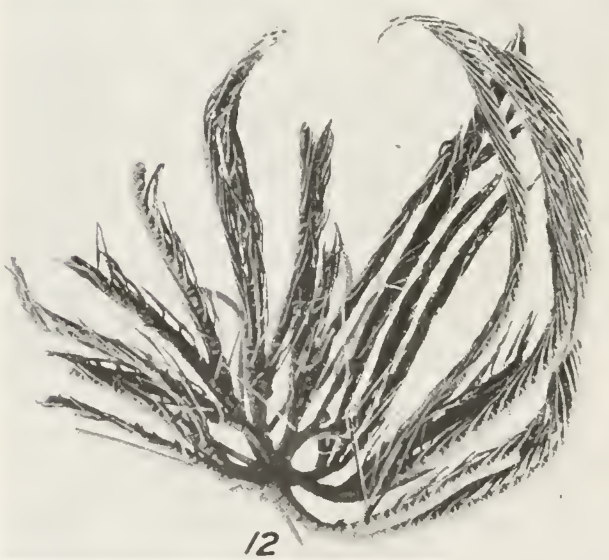
9, 10, *Cenometra bella:* The type specimen of *Antedon abbotti*, from Pulo Taya (U.S.N.M., 22644).



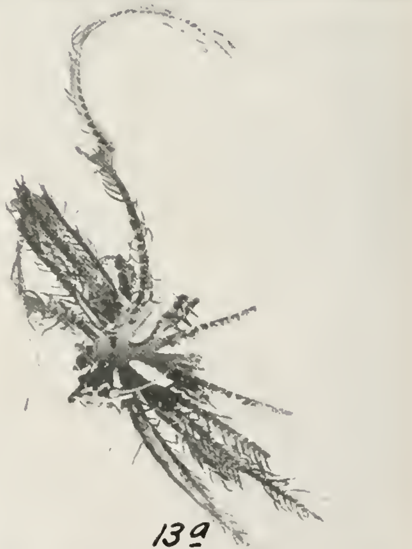
11



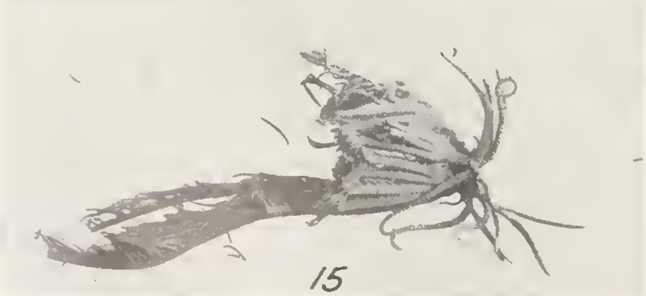
13



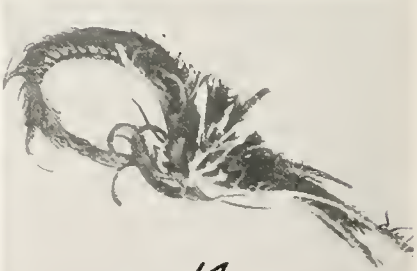
12



13a



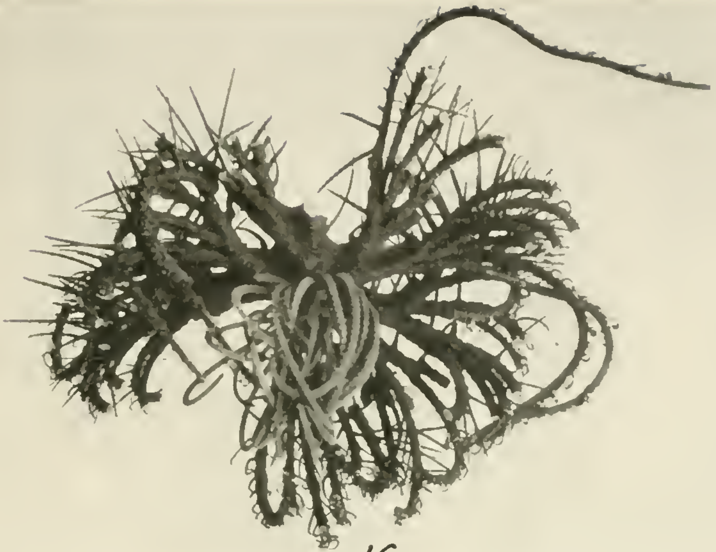
15



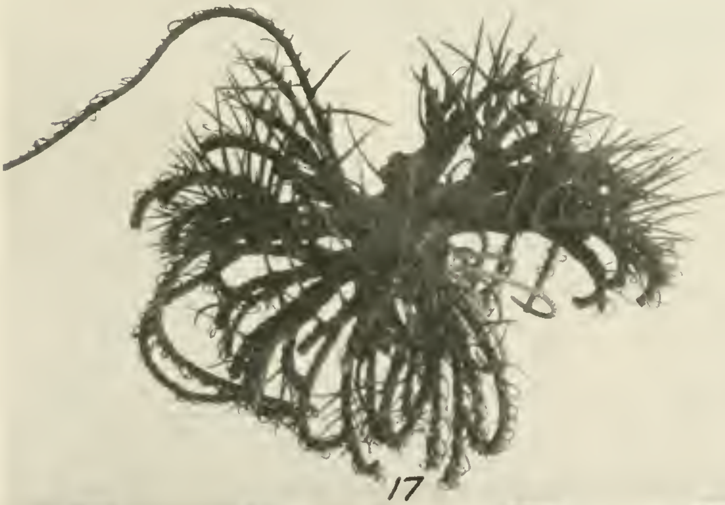
14

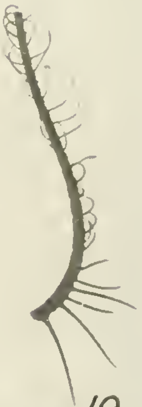
11, 12, *Epimetra nympha:* The type specimen from *Albatross* station 5356, × 2 (U.S.N.M., 27492).

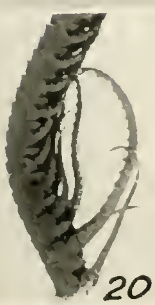
13–15, *Cenometra herdmani:* 13, 14, The type specimen of *Cenometra insueta* from the Arrakan coast of Burma (I.M.); 15, the type specimen of *Cenometra herdmani* from the Ganjam coast of India in 22 meters (I.M.).

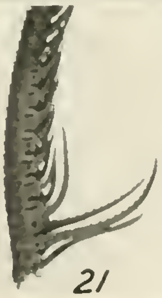

16

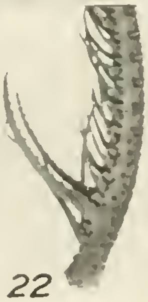
18

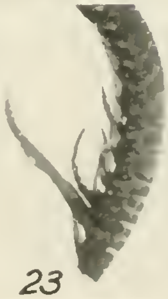

17

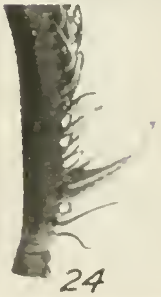

19


20


21

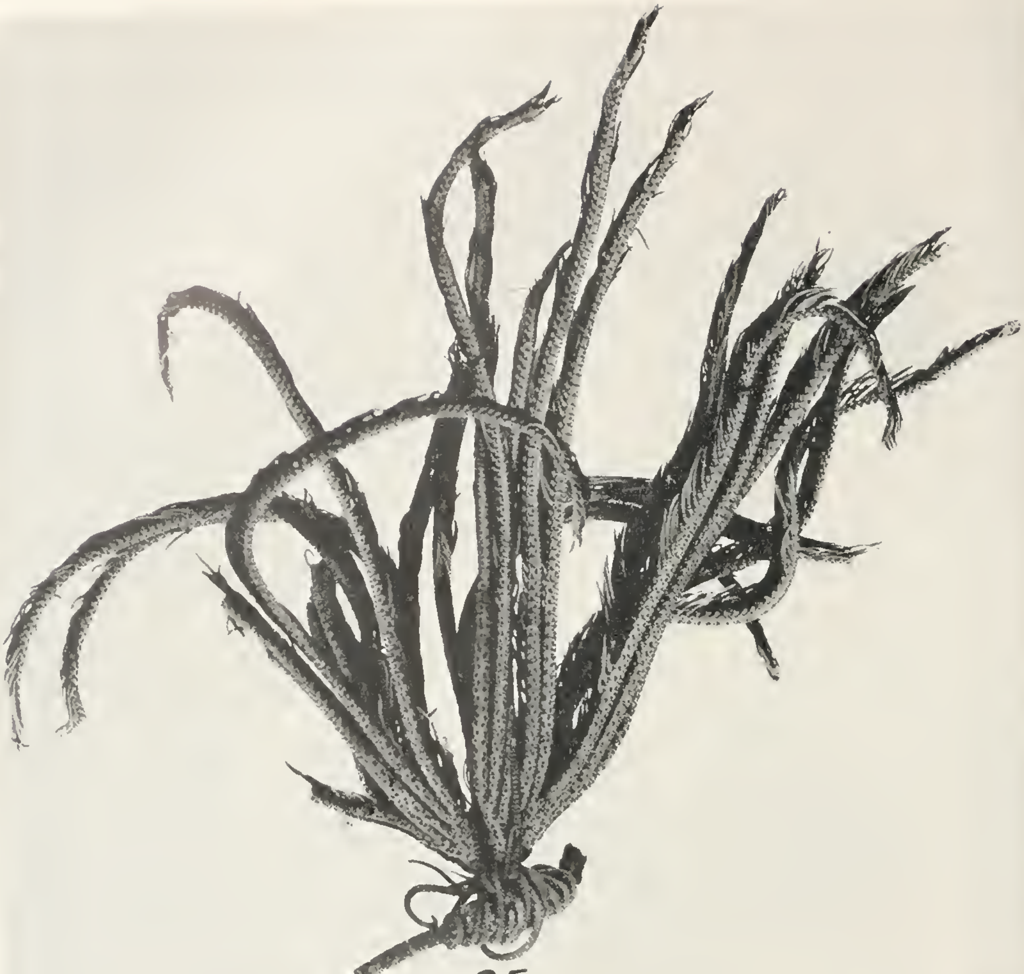

22


23

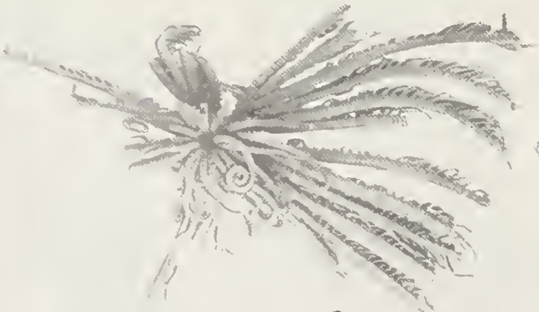

24

16–19, *Basilometra boschmai:* 16, 17, The type specimen from Ternate in 2–4 meters collected by the *Willebrord Snellius* (L.M.); 18, 19, proximal pinnules of the type specimen shown in figs. 16, 17 (L.M.).

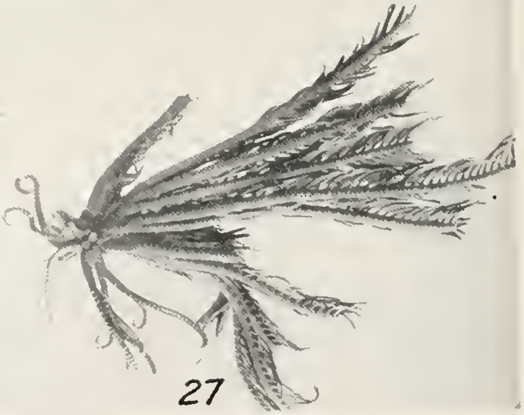
20–24, *Cenometra bella:* 20, Proximal pinnules of the type specimen of *C. unicornis* from *Albatross* station 5160, × 2 (U.S.N.M., 25441); 21, 22, proximal pinnules of a specimen from *Albatross* station 5160, × 2 (U.S.N.M., 35267); 23, proximal pinnules of a specimen from *Albatross* station 5160, × 2 (U.S.N.M., 36301); 24, proximal pinnules of the type specimen of *C. delicata* from *Albatross* station 5248, × 2 (U.S.N.M., 25465).



25

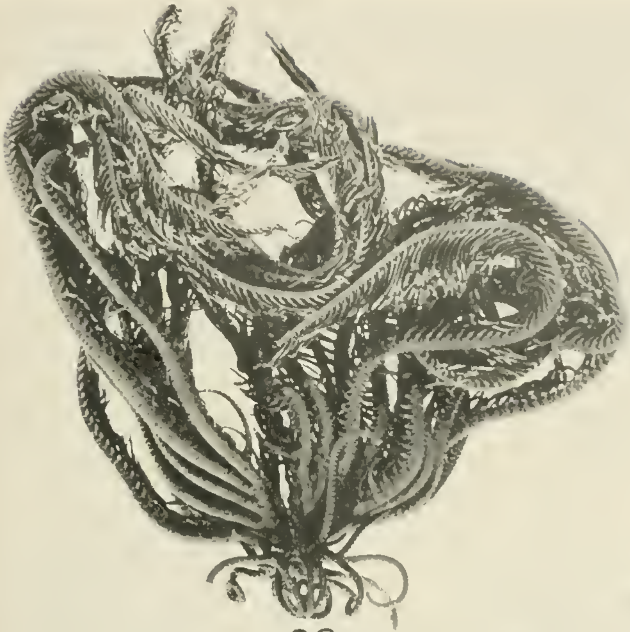


26

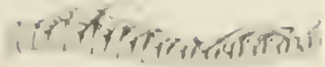


27

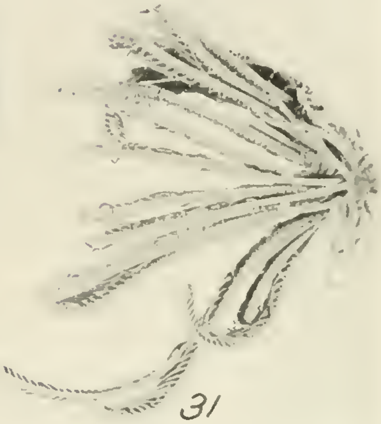
25, *Cenometra bella:* Specimen from *Albatross* station 5163 (U.S.N.M., 35269).
26, 27, *Cenometra herdmani:* The type specimen from the Ganjam coast of India in 22 meters (I.M.).



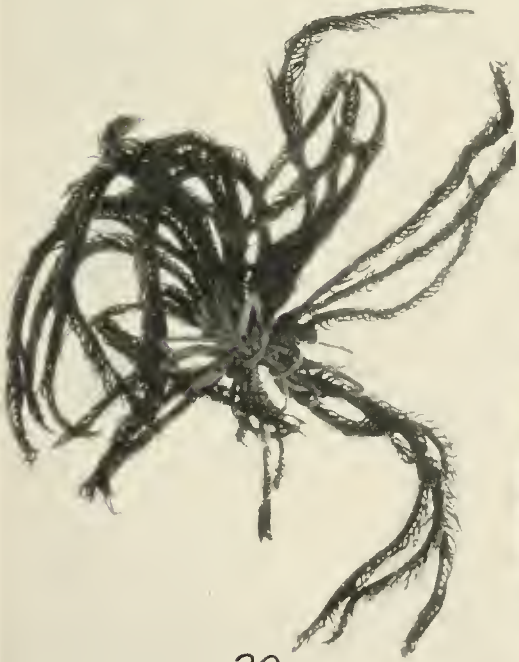
28



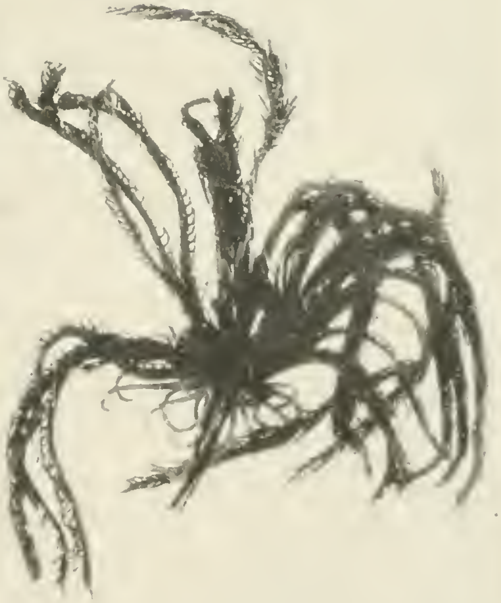
32



31



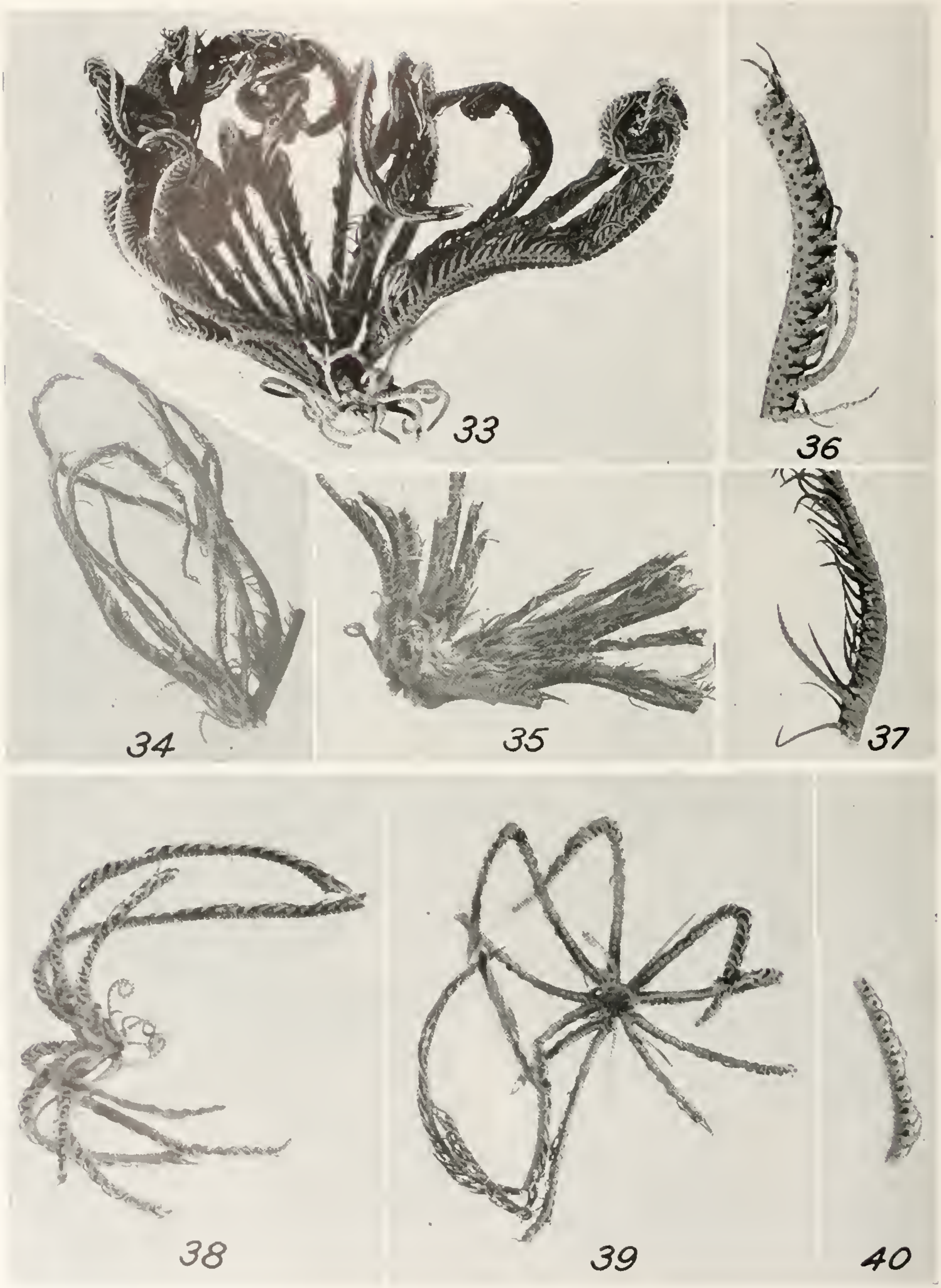
29



30

28–30, *Cenometra bella:* 28, The type specimen of *C. unicornis* from *Albatross* station 5160 (U.S.N.M., 25441); 29, 30, the type specimen of *C. delicata* from *Albatross* station 5248 (U.S.N.M., 25465).

31, 32, *Cenometra herdmani:* 31, A cotype from the Ganjam coast of India in 22 meters (U.S.N.M., 35303); 32 proximal pinnules of the cotype shown in fig. 31, × 2 (U.S.N.M., 35303).

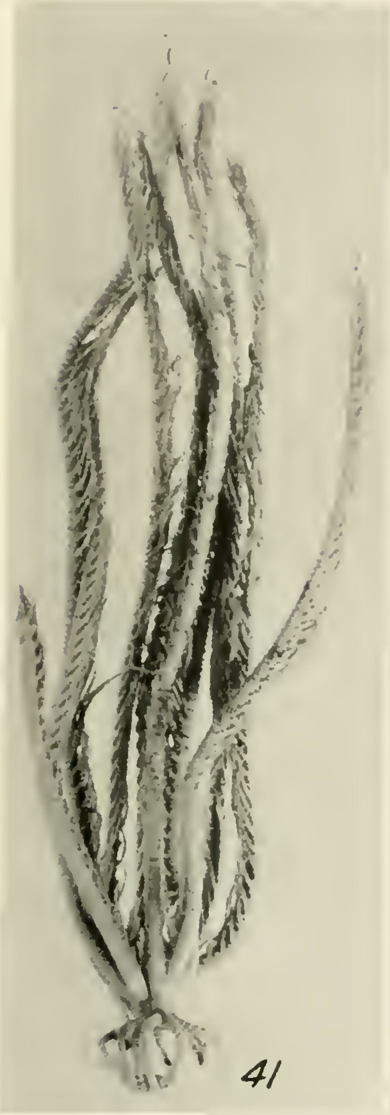


33, 35, 36. *Cenometra herdmani:* 33, A specimen from off Gopalpore in 46–51 meters (U.S.N.M., 35304); 35, the type specimen from the Ganjam coast of India in 22 meters (I.M.); 36, the proximal pinnules of the specimen shown in figure 33, × 2 (U.S.N.M., 35304).

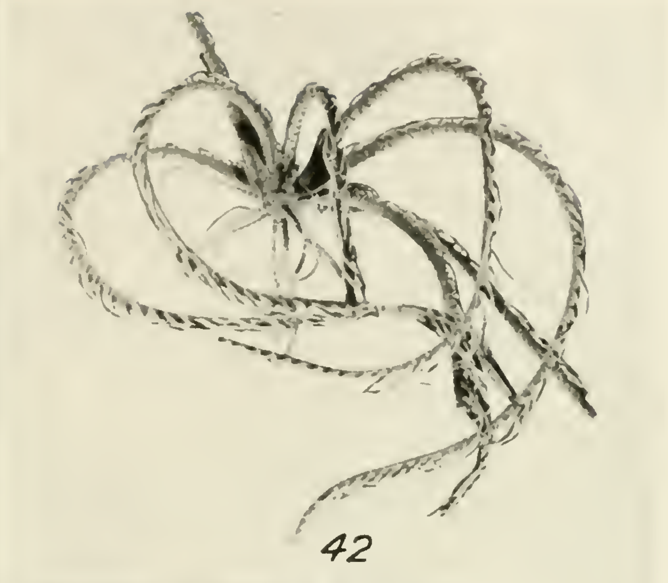
34, *Cenometra emendatrix:* Specimen from Mauritius (Berl. Mus., 5349).

37. *Cenometra bella:* Proximal pinnules of a specimen collected by the Danish Expedition to the Kei Islands off Neira, Banda, × 2 (U.S.N.M., E. 3230).

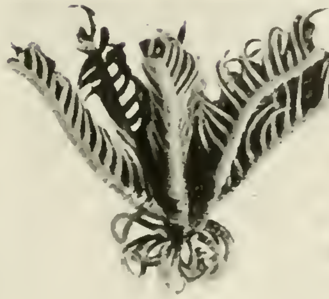
38–40. *Cotylometra gracilicirra gracilicirra:* 38, 39, The type specimen from *Albatross* station 5355, × 2 (U.S.N.M., 27493); 40, proximal pinnules of the type specimen shown in figs. 38, 39, × 2 (U.S.N.M., 27493).



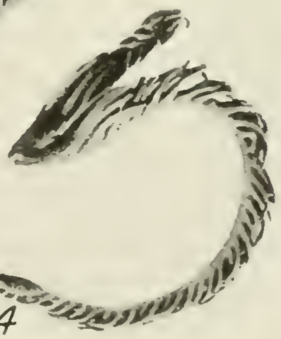
41



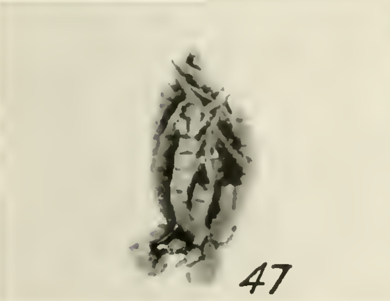
42



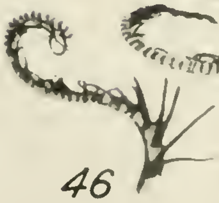
43



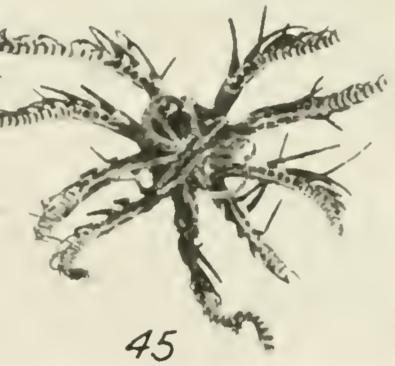
44



47



46



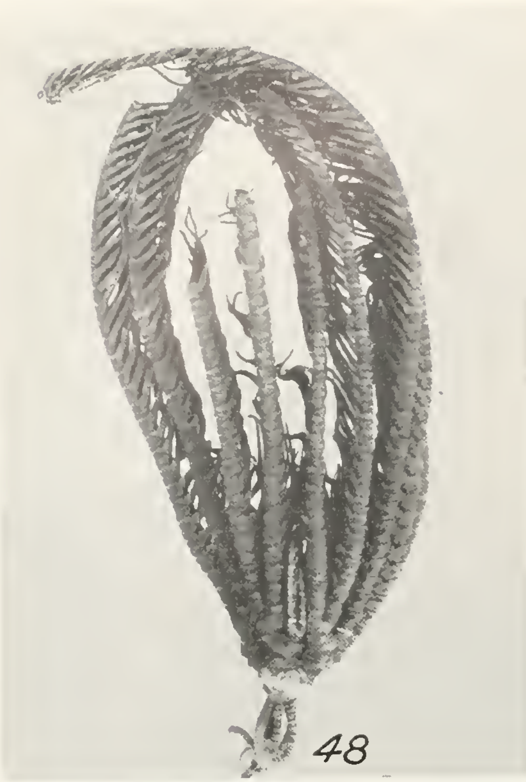
45

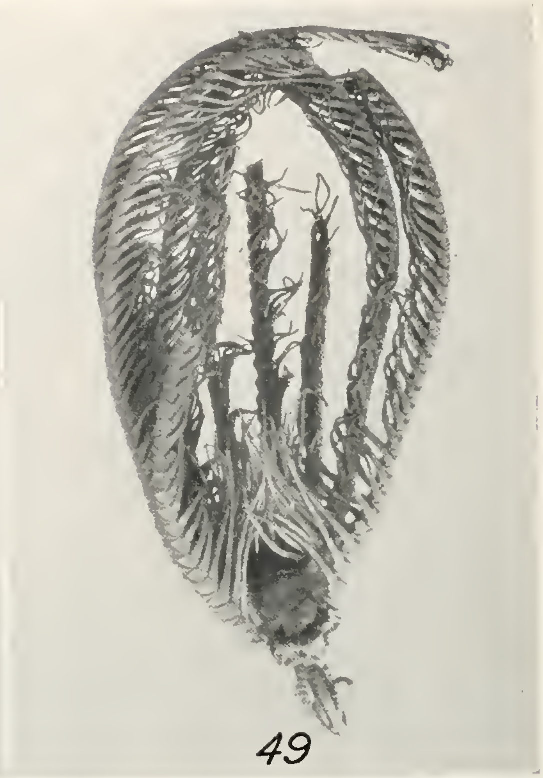
41, 42. *Cotylometra gracilicirra gracilicirra:* 41, A specimen from *Siboga* station 305, × 2 (Amsterdam Mus.); 42, a specimen from *Albatross* station 5356, × 2 (U.S.N.M., 35364).

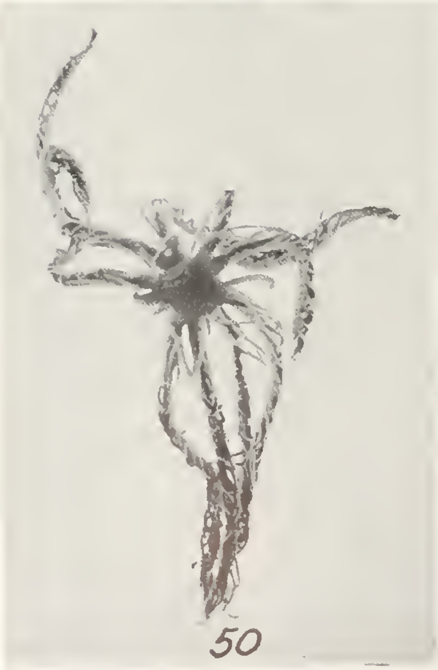
43, 44. *Oligometrides adeonae:* 43, A specimen from *Siboga* station 273, × 2 (Amsterdam Mus.); 44, proxima pinnules of the specimen shown in fig. 43, × 2 (Amsterdam Mus.).

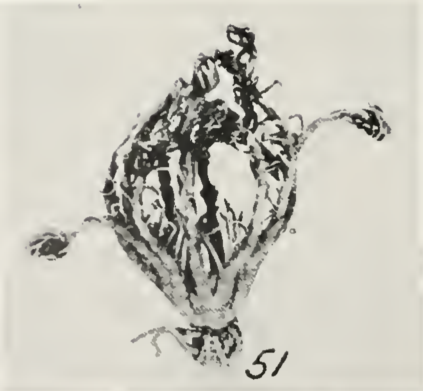
45, 46. *Iconometra anisa:* 45, A specimen from Great Barrier Reef Expedition station XIX, × 2 (B.M.); 46, proximal pinnules of the specimen shown in fig. 45, × 2 (B.M.).

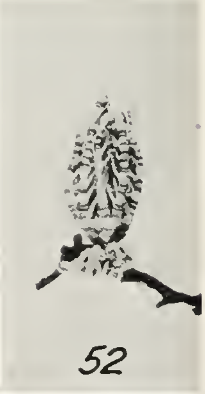
47, *Analcidometra caribbea:* The type specimen from *Albatross* station 2146, × 3 (U.S.N.M., 22676).

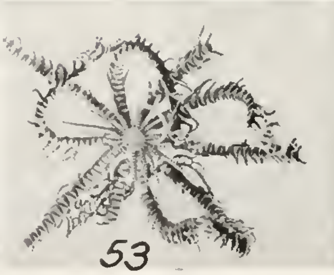

48

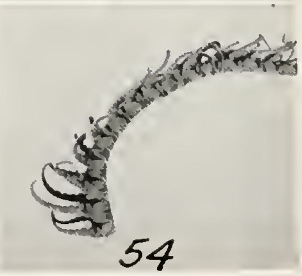

49


50


51


52

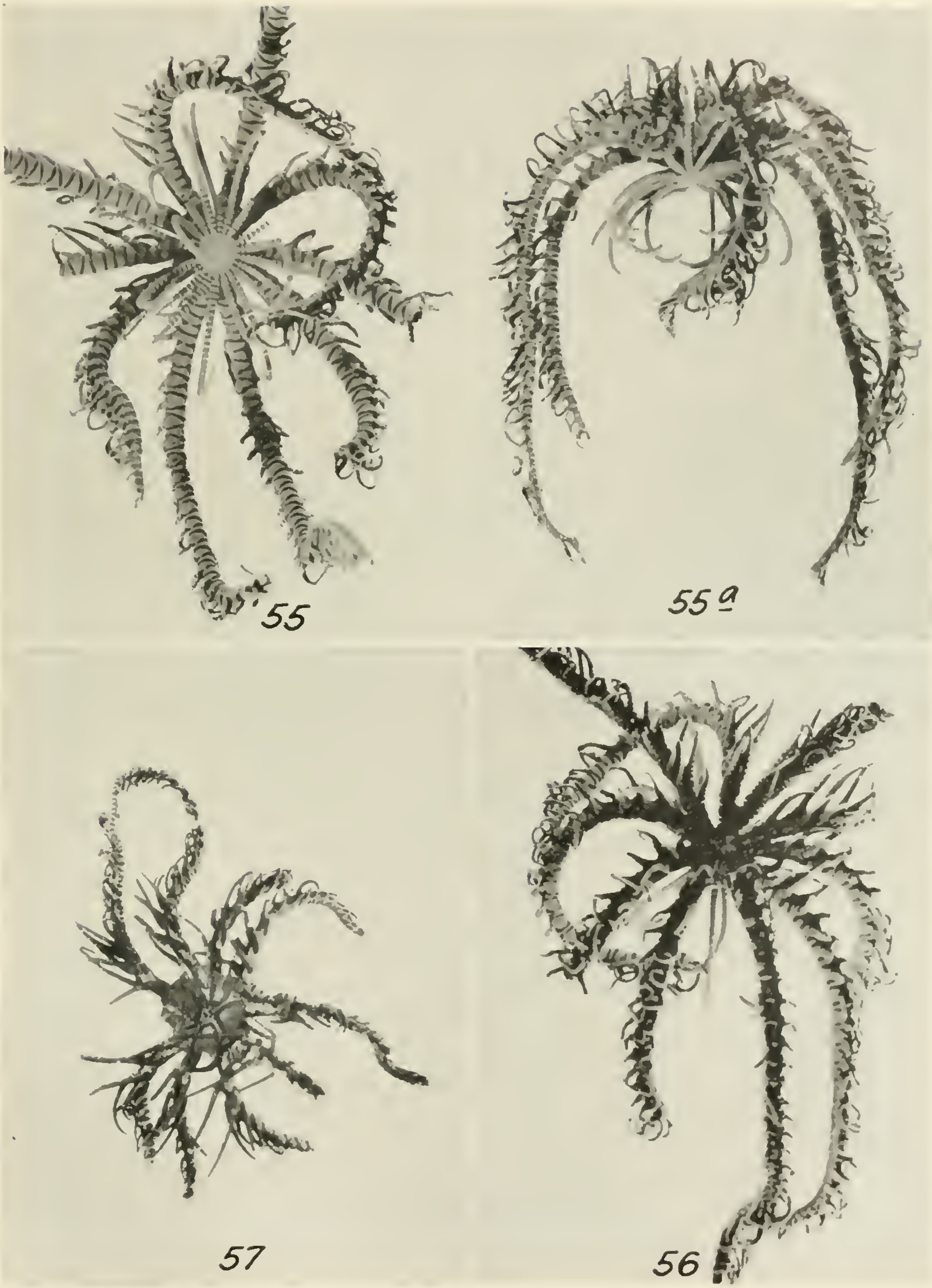

53


54

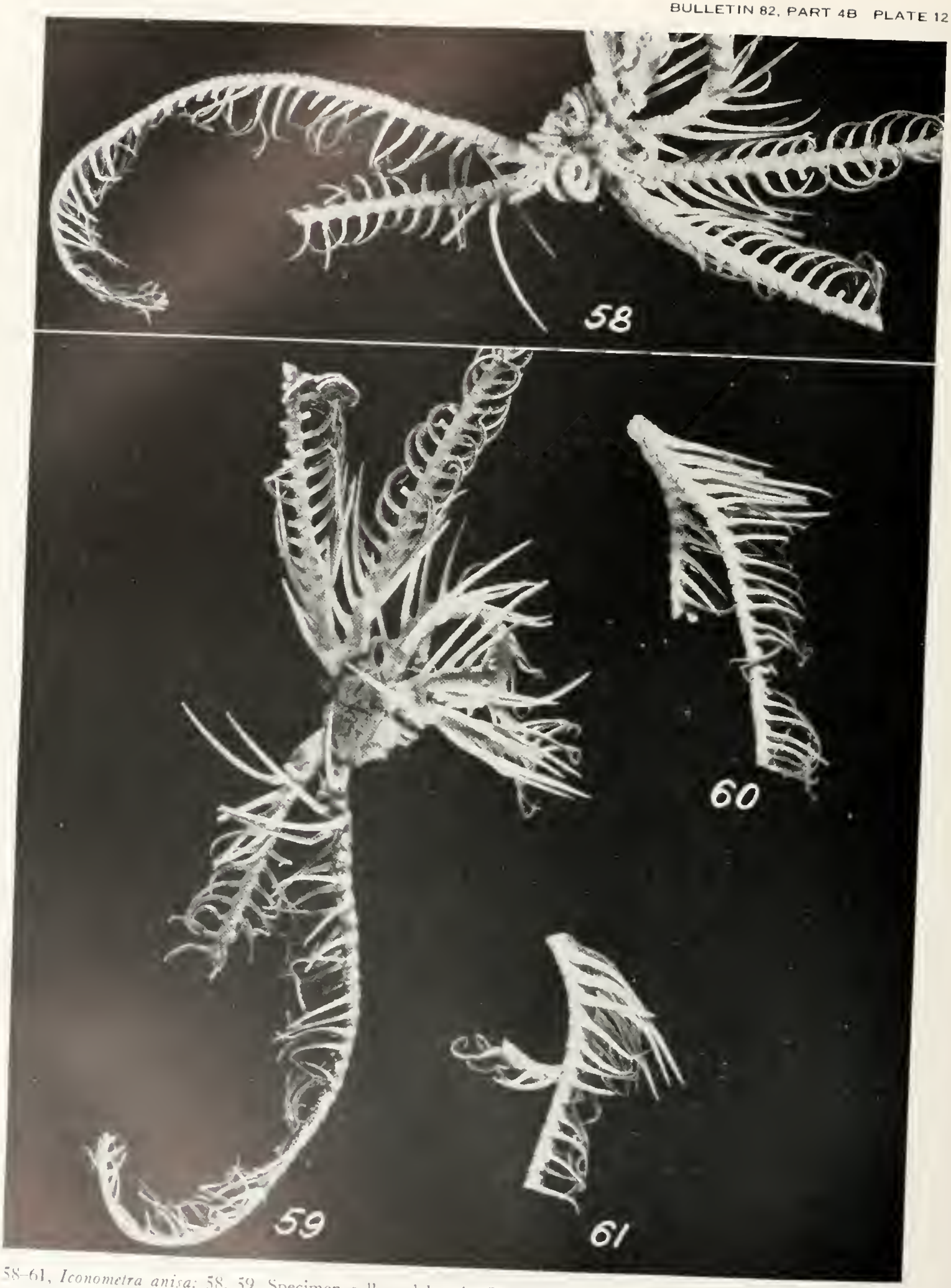
48, 49, *Iconometra speciosa:* The type specimen from off Cape Padaran, southern Annam, in 146 meters, collected by the *Patrol*, × 2 (B.M.).

50–52, *Iconometra marginata:* 50, The type specimen from *Siboga* station 305, × 2 (Amsterdam Mus.); 51, 52, two specimens from *Willebrord Snellius* station 60, × 3 (L.M.).

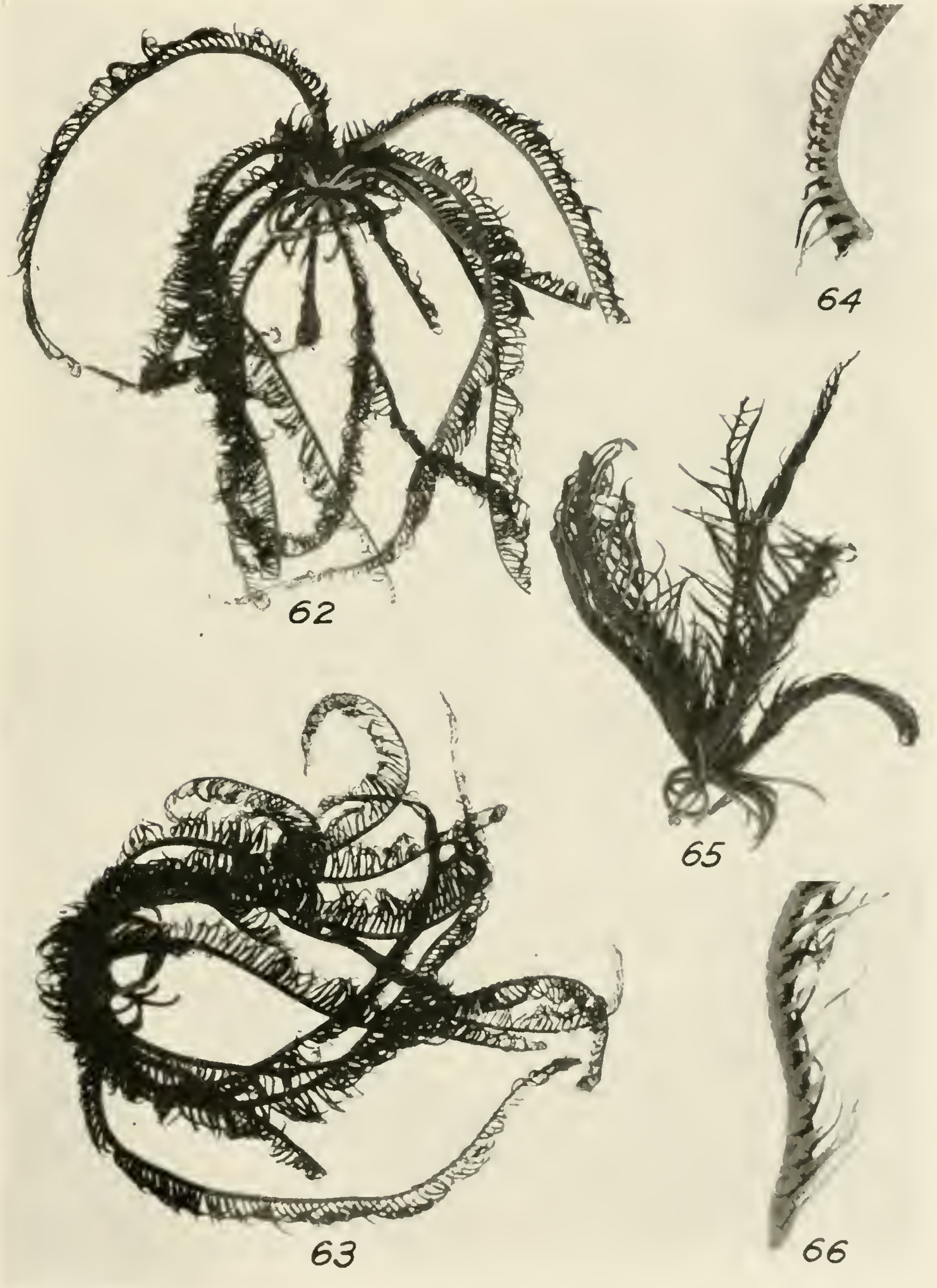
53, 54, *Iconometra japonica:* 53, A specimen from near Misaki in 10–15 meters (U.S.N.M., 35772); 54, proximal pinnules of the specimen shown in fig. 53.



55, 55a, 56. *Iconometra japonica:* A specimen from near Misaki, Japan, in 10-15 meters, × 2 (U.S.N.M., 35772).
57. *Iconometra anisa:* A specimen from Great Barrier Expedition station XIX, × 2 (B.M.).

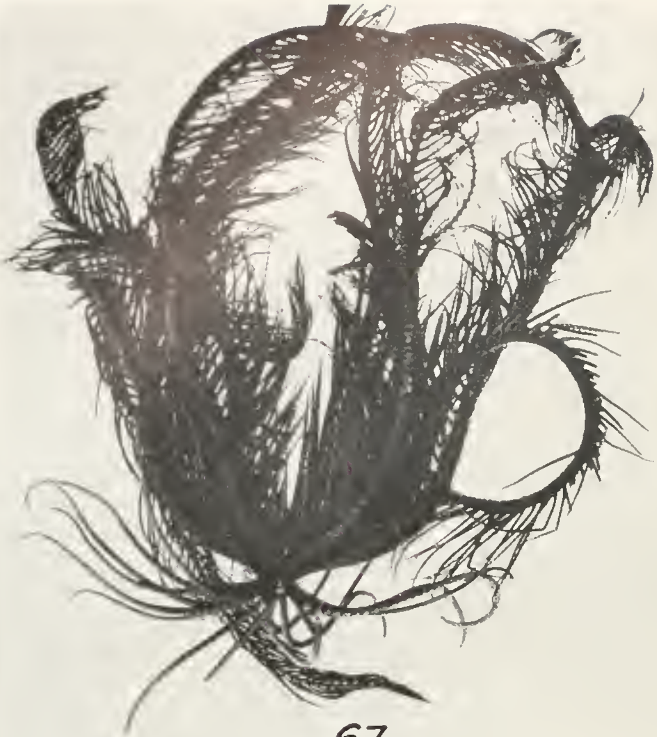


58–61, *Iconometra anisa:* 58, 59, Specimen collected by the Danish Expedition to the Kei Islands at Amboina Bay in about 183–238 meters, × (C.M.); 60, 61, proximal pinnules of the specimen shown in figs. 58 59, × 2 (C.M.).

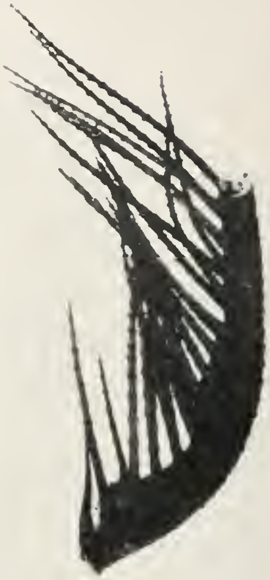


62–64, *Petasometra clarae:* 62, 63, A specimen from *Siboga* station 341 (Amboina), × 2 (U.S.N.M., E. 419); 64, proximal pinnules of the specimen shown in figs. 62, 63, × 2 (U.S.N.M., E. 419).

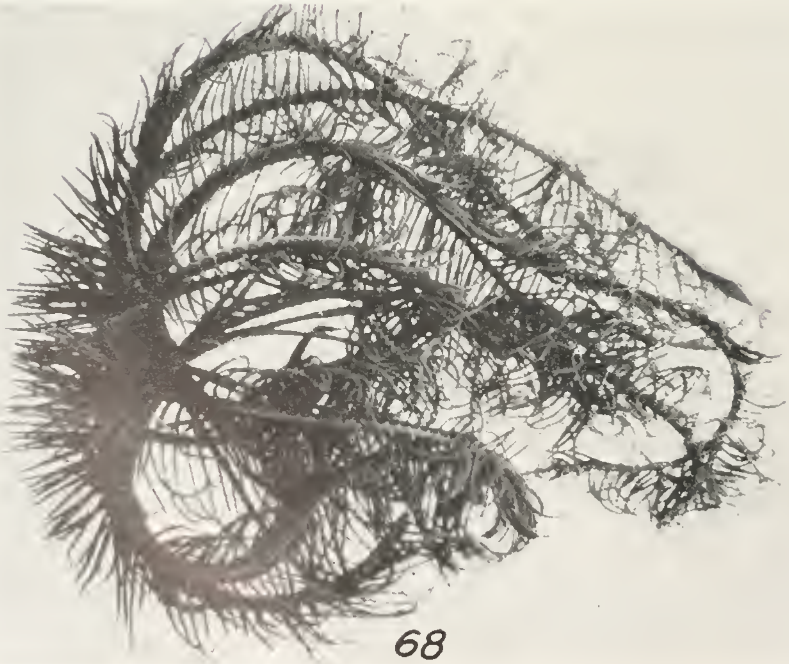
65, 66, *Alisometra owstoni:* 65, A specimen from Sagami Bay, Japan, in 100 meters, × 2 (U.S.N.M., 35631); 66, proximal pinnules of the specimen shown in fig. 65, × 3 (U.S.N.M., 35631).



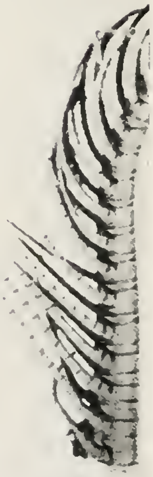
67



69



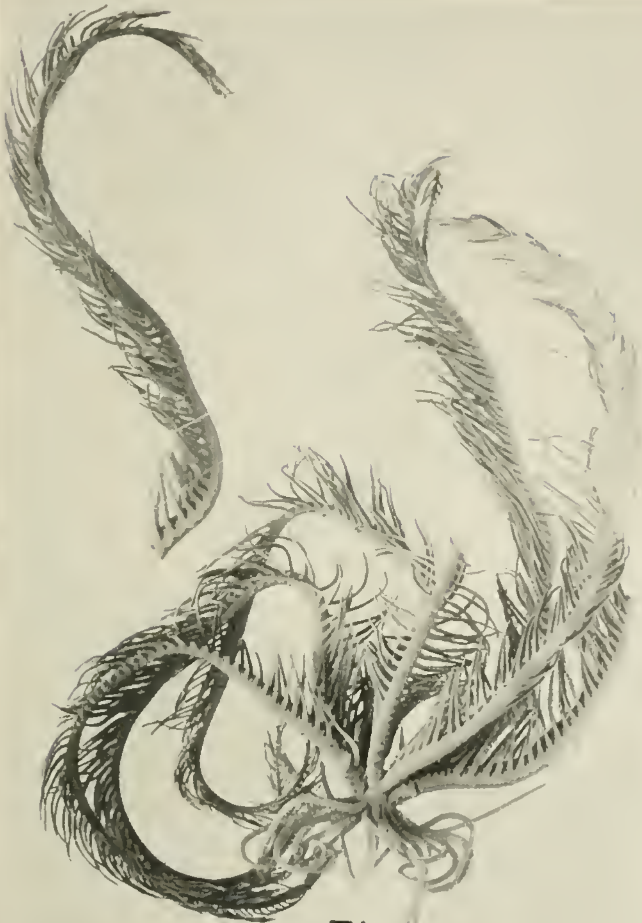
68



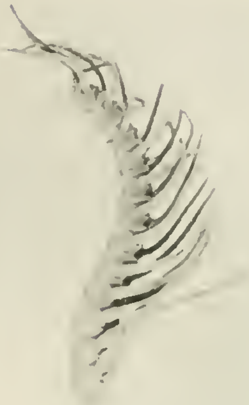
70

67–69, *Colobometra perspinosa:* 67, A specimen from Binongko, Toekang Besi Islands in 6–10 meters, collected by the *Willibrord Snellius* (U.S.N.M., E. 5271); 68, a specimen from Ternate in 2–4 meters, collected by the *Willibrord Snellius* (L.M.); 69, proximal pinnules of the specimen shown in fig. 67, × 2 (U.S.N.M., E. 5271).

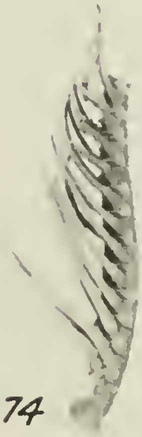
70, *Colobometra perspinosa* var. *vepretum:* Proximal pinnules of a cotype from Singapore, × 2 (U.S.N.M., 35313).



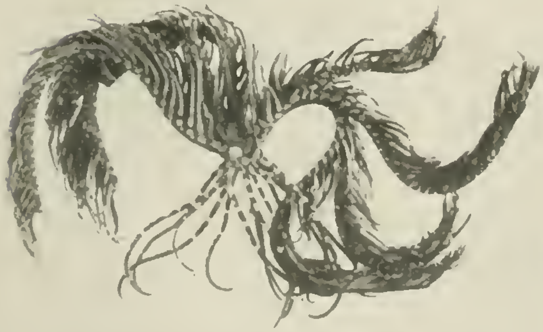
71



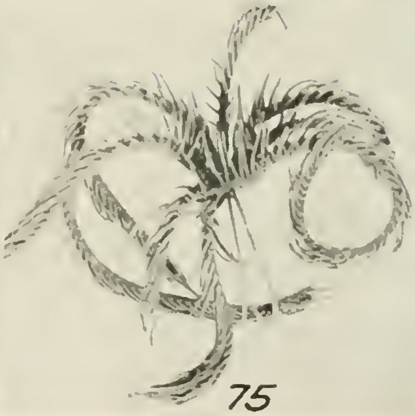
73



74



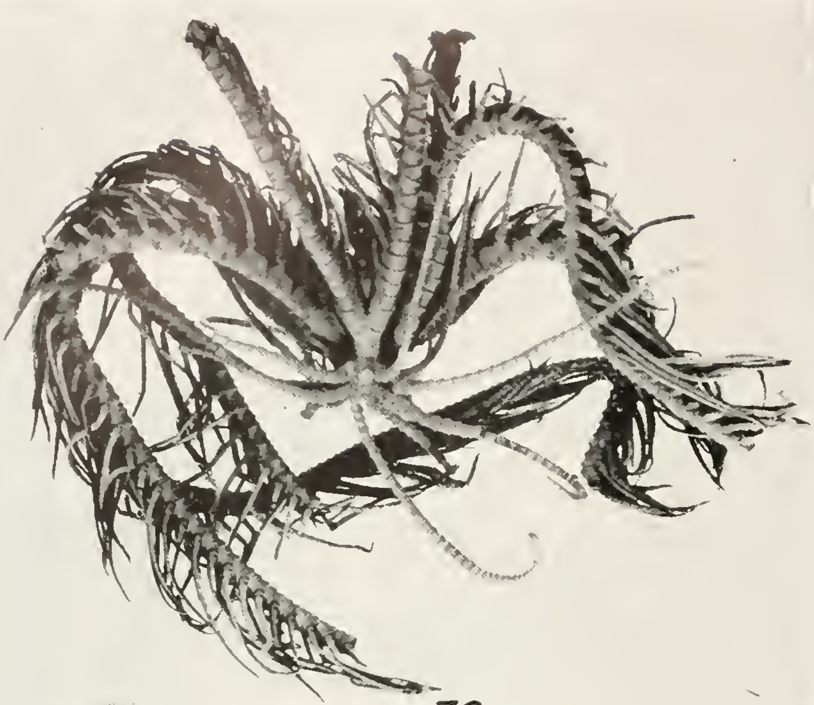
72

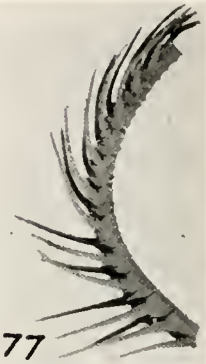


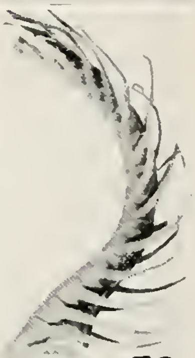
75

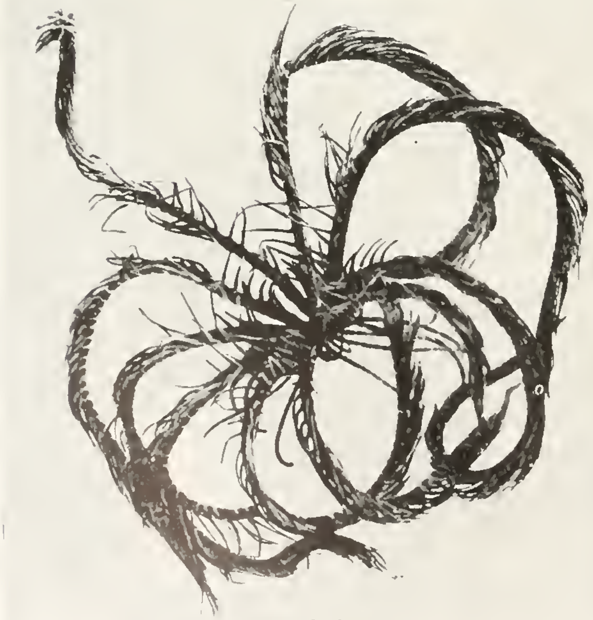
71, *Colobometra perspinosa* var. *vepretum:* The type specimen from Singapore (C.M.).

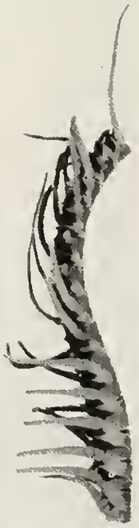
72–75, *Colobometra discolor:* 72, The type specimen from lat. 14 01′30″ N., long. 93°51′00″ E., in 75 meters (I.M.); 73, 74, proximal pinnules of the type specimen shown in fig. 72, × 2 (I.M.); 75, a specimen from *Albatross* station 5356 (U.S.N.M., 35316).

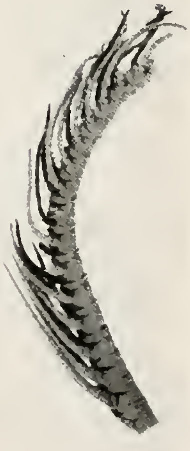

76


77


78

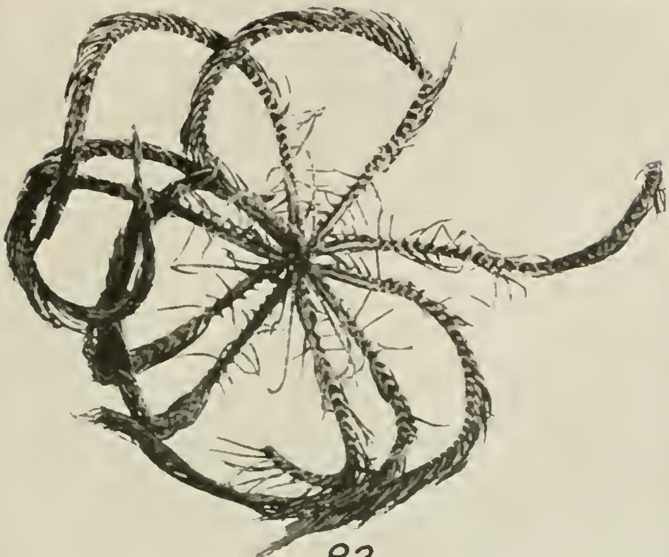

80


81

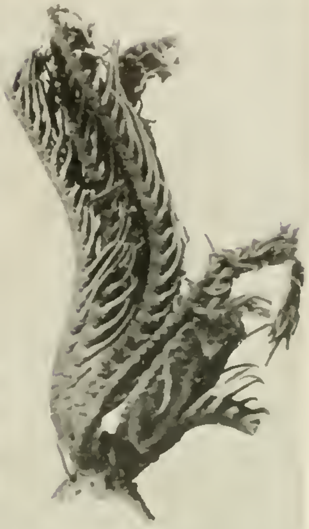

79

76–79. *Colobometra discolor:* 76, A specimen from lat. 8°51′30″ N., long. 81°11′52″ E., in 51 meters, × 2 (U.S.N.M., 35324); 77, proximal pinnules of a specimen from *Albatross* station 5356, × 2 (U.S.N.M., 35313); 78, proximal pinnules of the specimen shown in fig. 76, × 2 (U.S.N.M., 35324); 79, proximal pinnules of a specimen from *Investigator* station 387, × 2 (U.S.N.M., 35347).

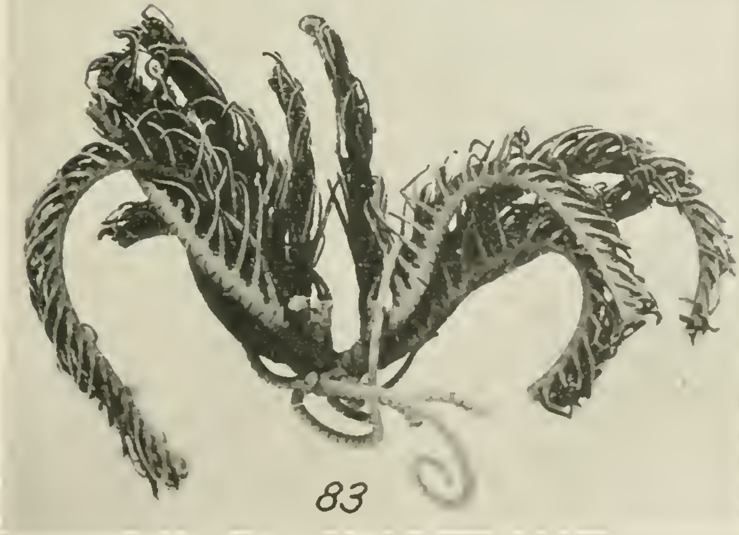
80, 81. *Colobometra suavis:* 80, The type specimen from *Albatross* station 5137 (U.S.N.M., 25443); 81, proximal pinnules of the type specimen shown in fig. 80, × 2 (U.S.N.M., 25443).



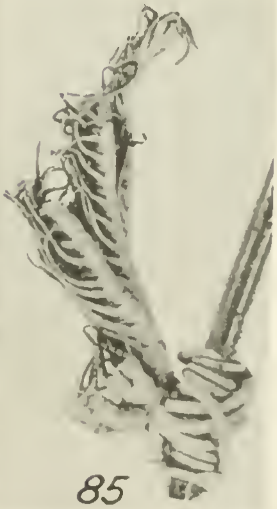
82



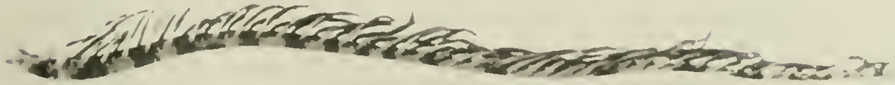
84



83

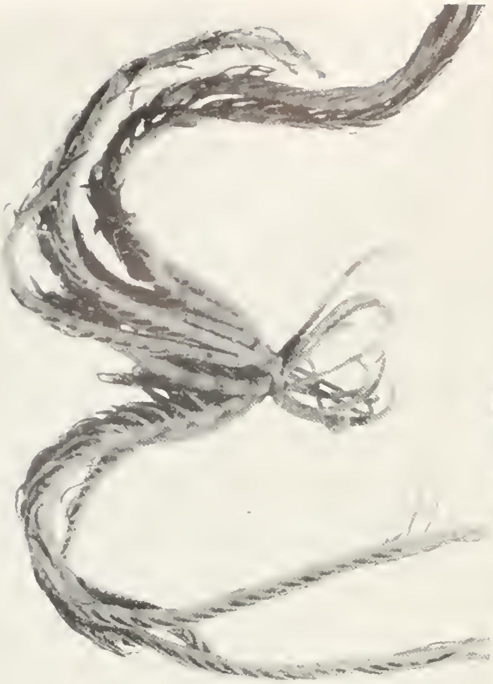


85

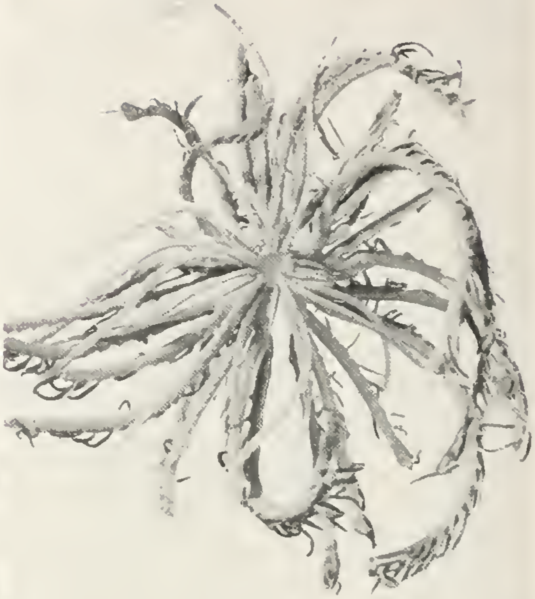


86

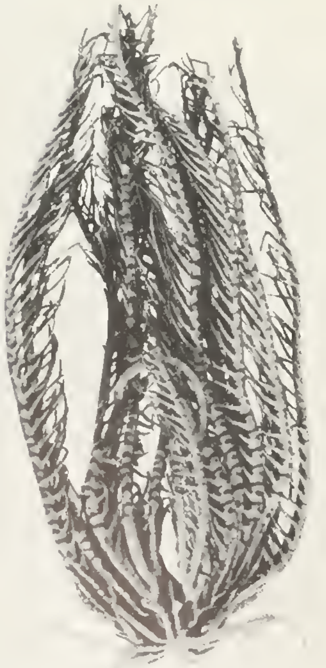
82, *Colobometra suavis.* The type specimen from *Albatross* station 5137 (U.S.N.M., 25443).
83–85, *Cyllometra prashadi:* Specimen from *Investigator* station 535, × 2 (I.M.).
86, *Cyllometra manca:* Pinnules of a specimen from *Albatross* station 3707, × 2 (U.S.N.M., 35372)



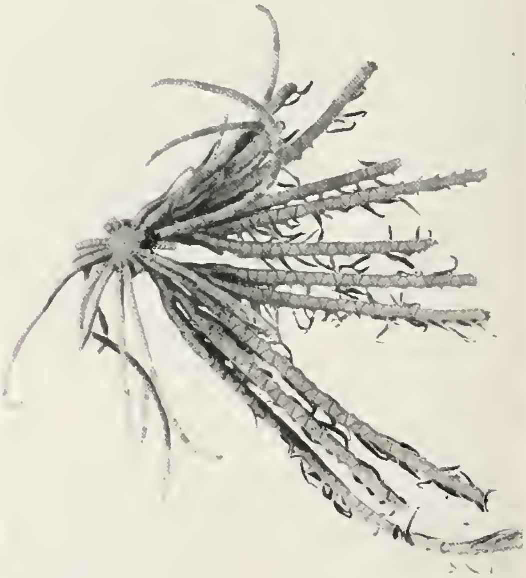
87



88



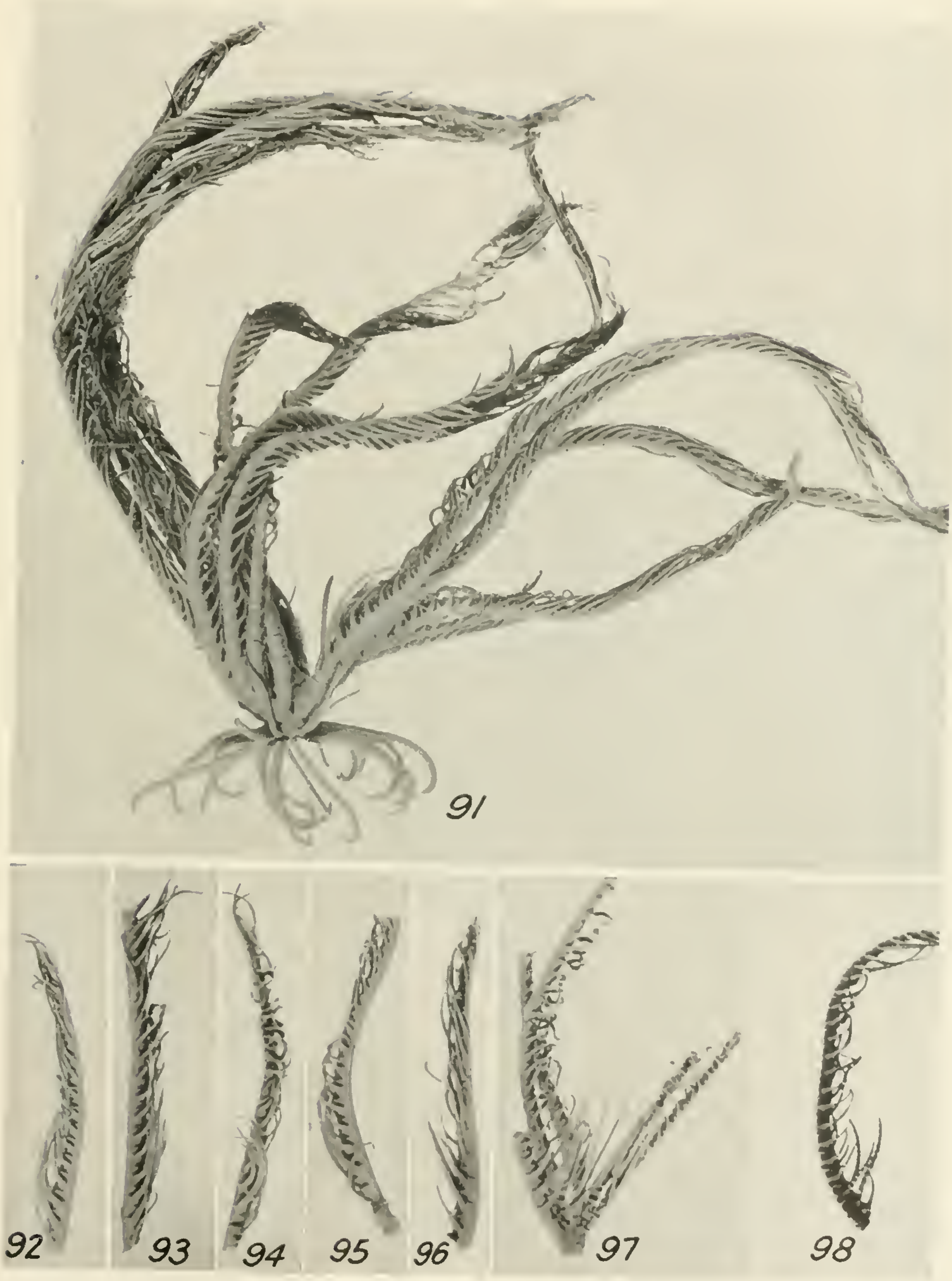
89



90

87, *Cyllometra manca:* A specimen from ?Kurrachi, × 2 (U.S.N.M., 35357).

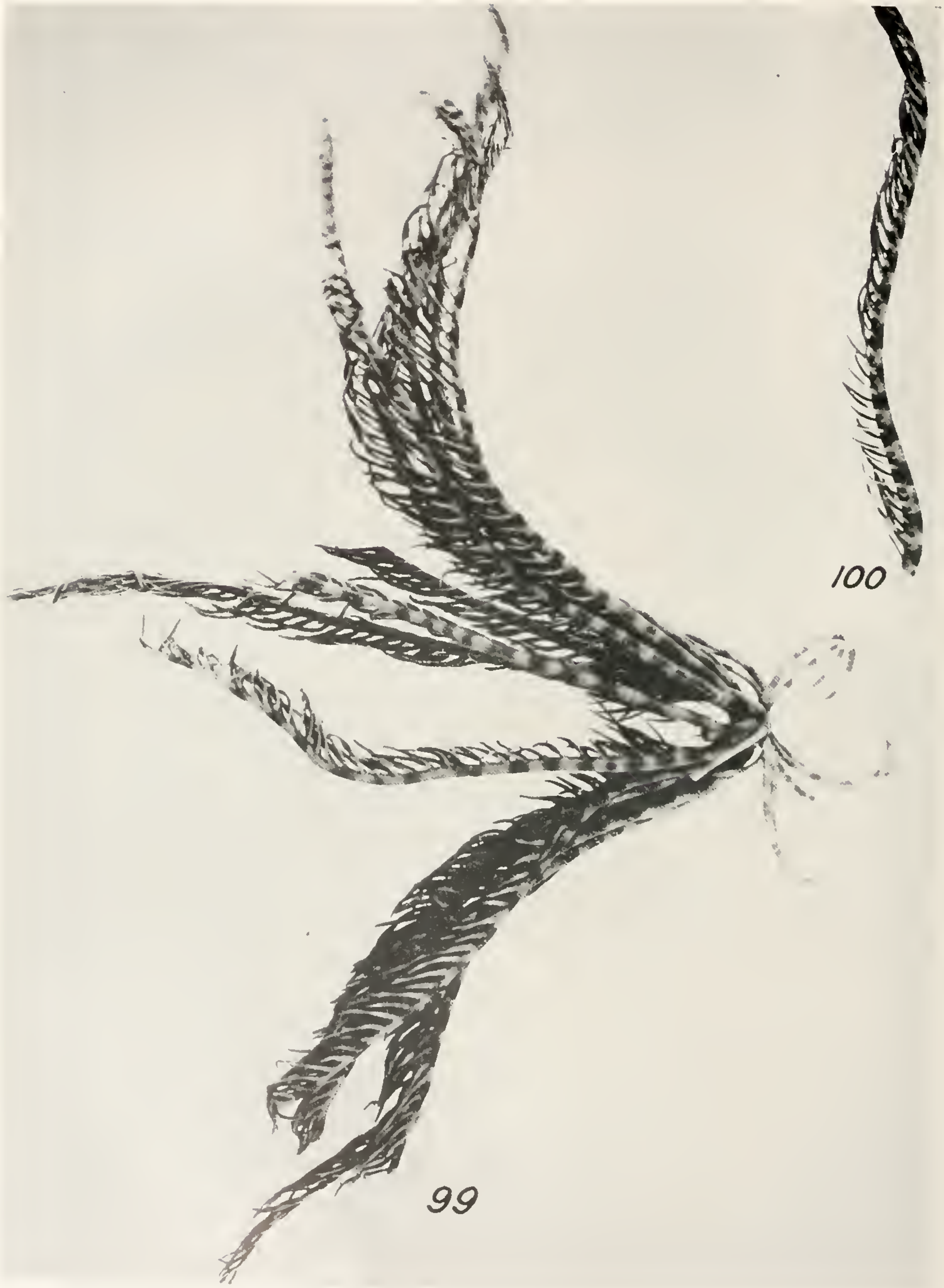
88–90. *Cyllometra gracilis:* 88, The type specimen from *Siboga* station 49*a*, × 2 (Amsterdam Mus.); 89, 90, cotypes from *Siboga* station 49*a*, × 2 (U.S.N.M., E. 433).



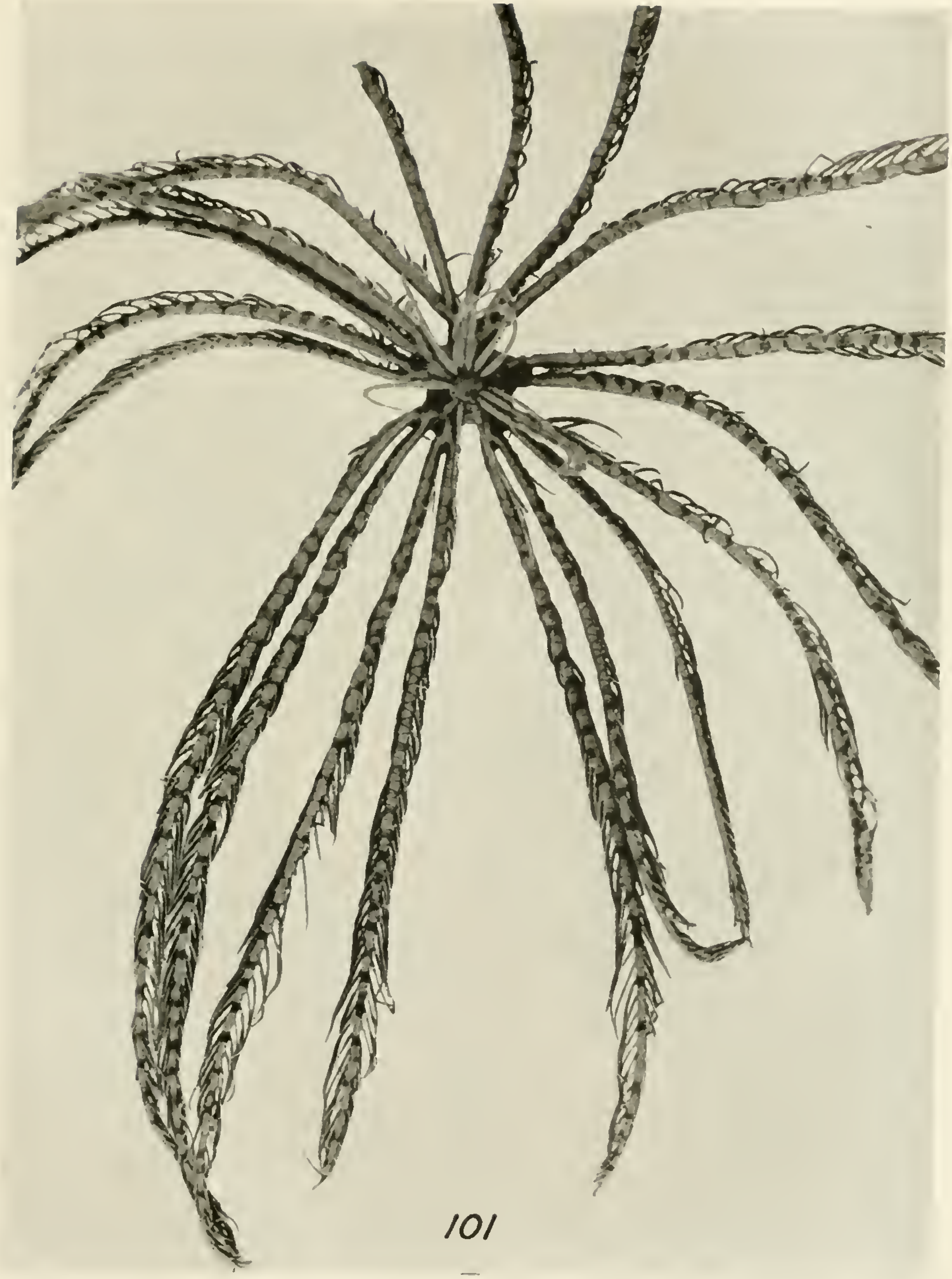
91–96. *Cyllometra manca:* 91, A specimen from *Albatross* station 5213, × 2 (U.S.N.M., 35314); 92–95, proximal pinnules from specimens from *Albatross* station 5213, × 2 (U.S.N.M., 35314); 96, proximal pinnules of a specimen from ?Kurrachi, × 2 (U.S.N.M., 35357).

97. *Cyllometra gracilis:* Proximal pinnules of a specimen from *Siboga* station 49*a*, × 2 (U.S.N.M., E. 433).

98. *Decametra tigrina:* Proximal pinnules of a specimen from Kogoshima Bay, Japan, × 2 (U.S.N.M., 3033).

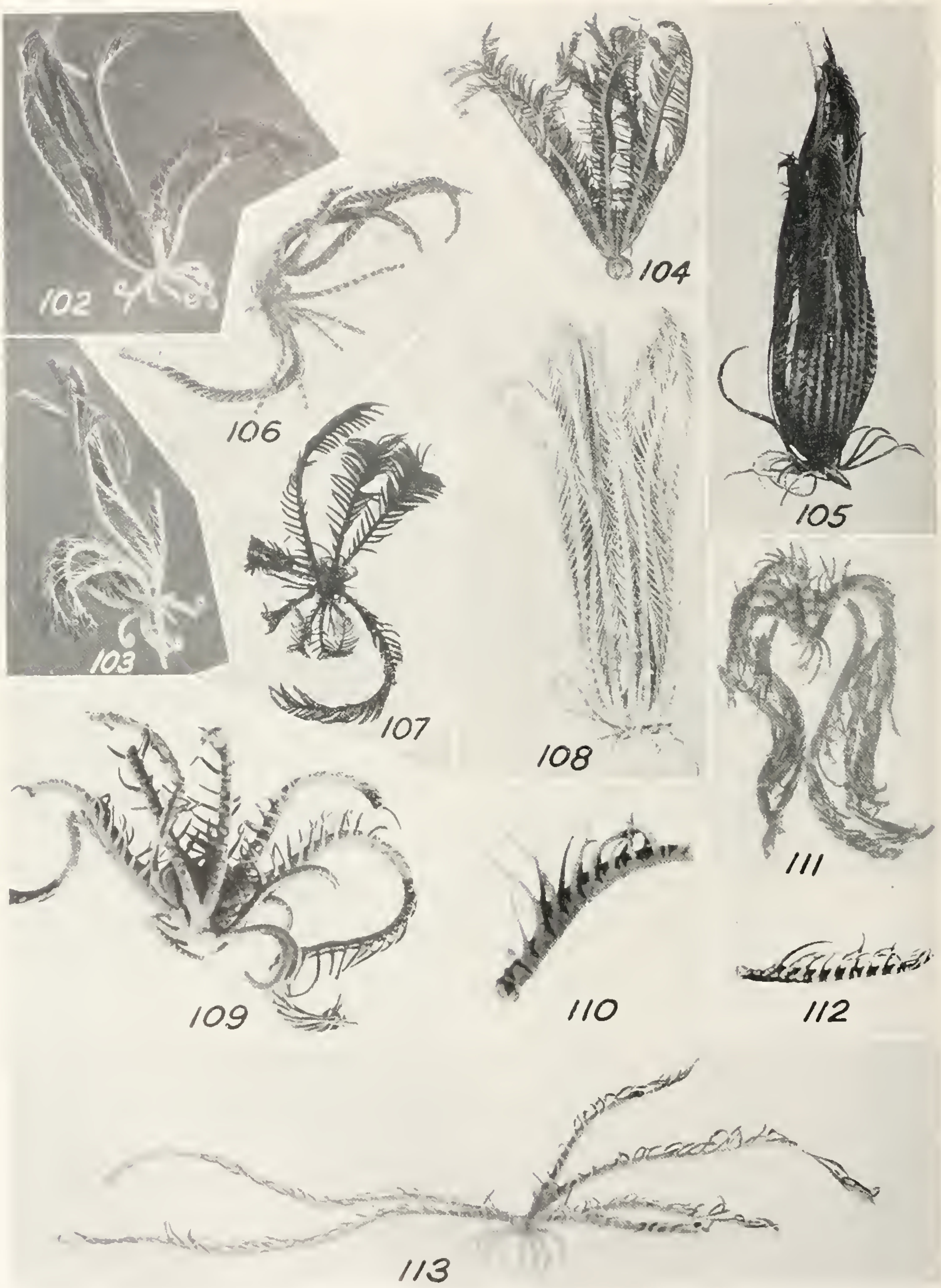


99, 100, *Cyllometra manca:* 99, A specimen from *Albatross* station 3707, × 2 (U.S.N.M., 37372); 100, proximal pinnules of the specimen shown in fig. 99, × 2 (U.S.N.M. 37372).



101

101, *Cyllometra manca:* Specimen collected by the *Albatross* in Sagami Bay, Japan, × 2 (U.S.N.M., 35360).



102–108, *Cyllometra manca:* 102, 103, The type specimen of *C. soluta* from the Straits of Ormuz in 88–89 meters (I.M.); 104, 105, specimens from lat. 33°10′ N., long. 129°18′ E., in 73 meters (C.M.); 106, the type specimen of *C. anomala* from Japan (C.M.); 107, specimen from lat. 33°08′ N., long. 129°20′ E., in 66 meters (C.M.); 108, specimen from southern Japan (C.M.).

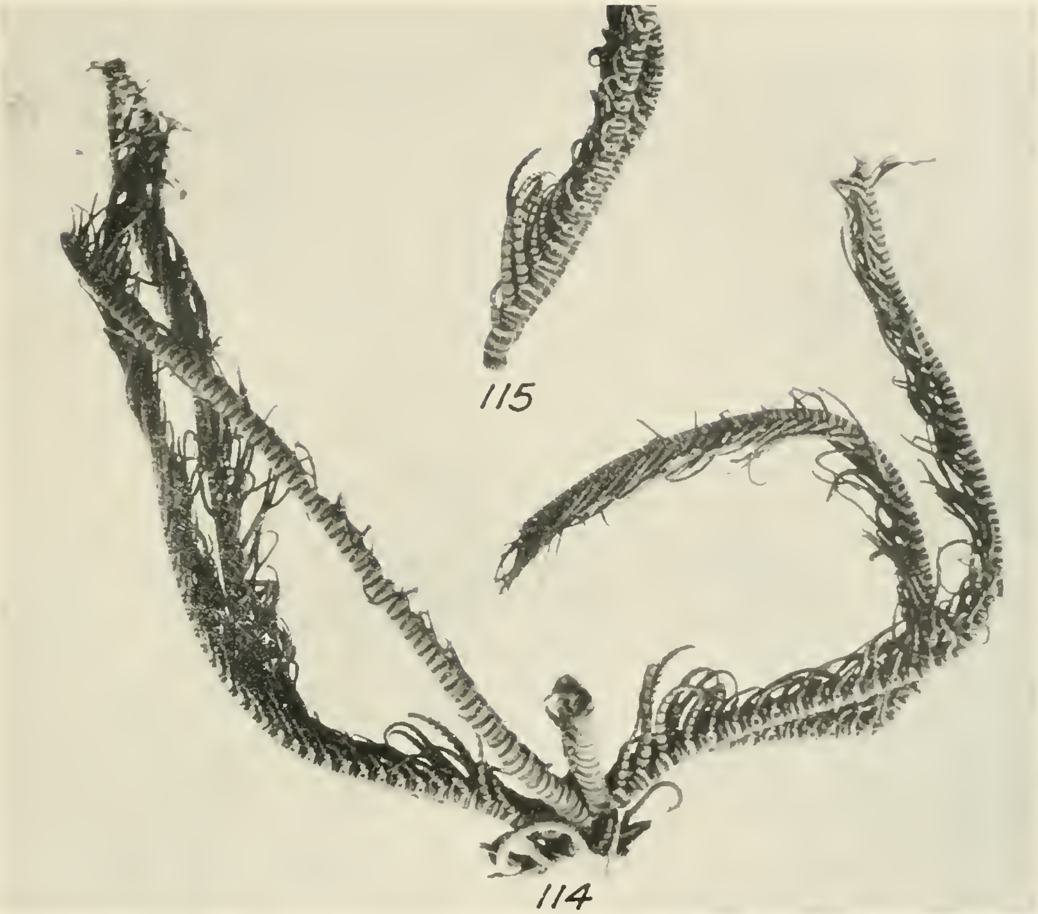
109, *Decametra laevipinna:* The type specimen collected by the *Siboga* at Salayer, × 2 (Amsterdam Mus.).

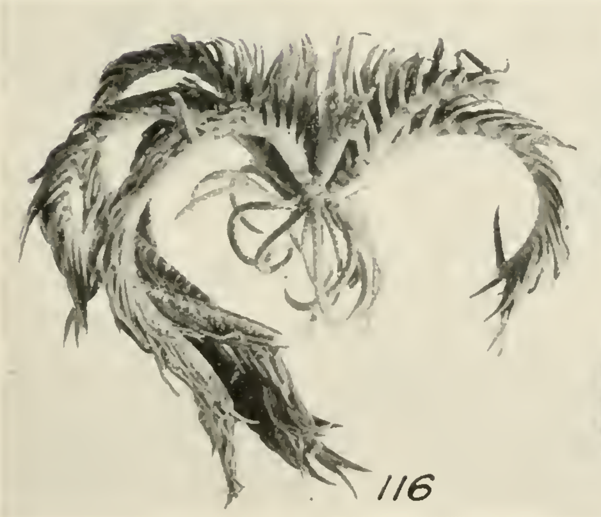
110, *Decametra mylitta:* Proximal pinnules of a specimen from off Jolo in 36 meters collected by Dr. Th. Mortensen, × 3 (U.S.N.M., E. 3242).

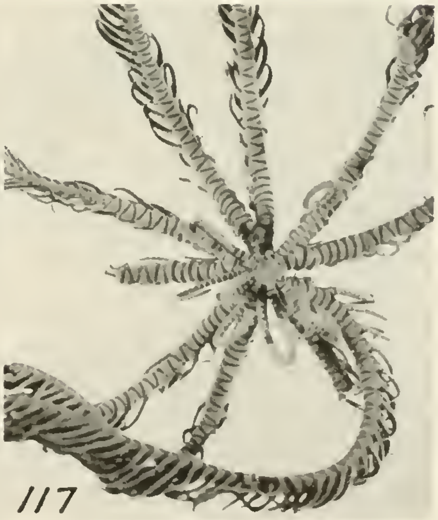
111, *Decametra modica:* The type specimen from Bagamoyo, Tanganyika Territory (Berl. Mus.).

112, *Decametra tigrina:* Proximal pinnules of a specimen from Kagoshima Bay, Japan (U.S.N.M., 3033).

113, *Decametra parva:* The type specimen from *Siboga* station 315, × 2 (Amstrdam Mus.).

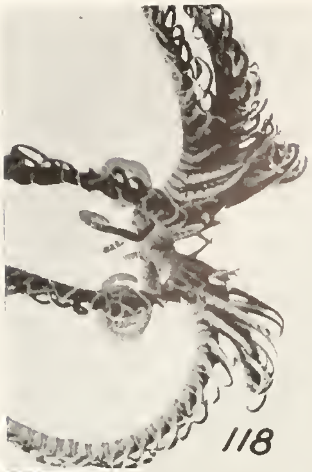


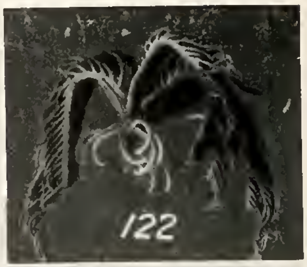


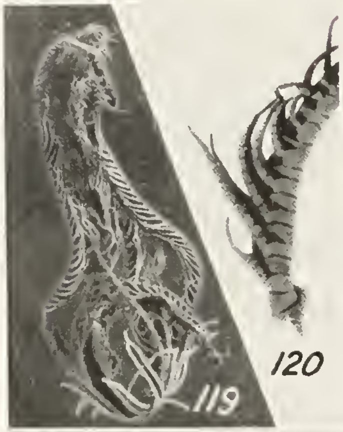


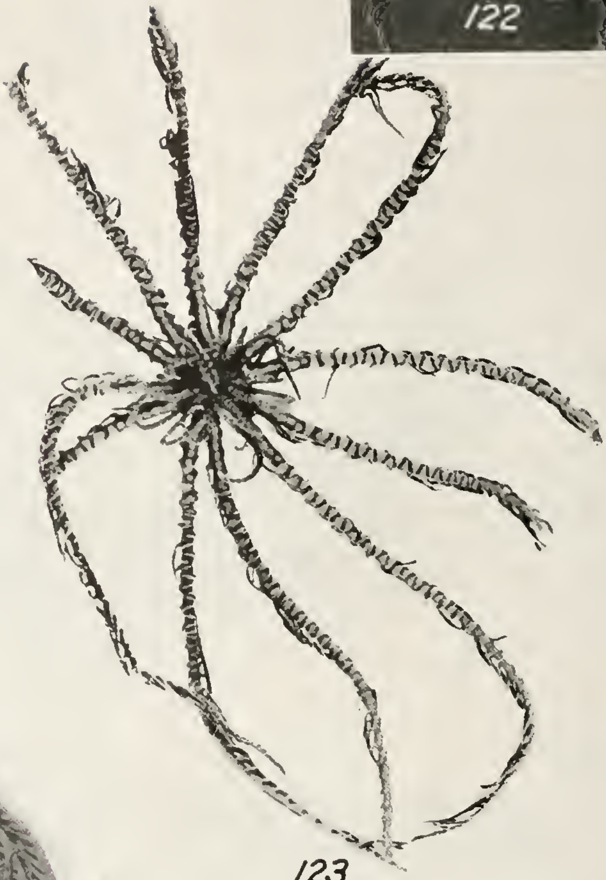
114, 115, *Decametra alaudae:* 114, Specimen from Cargados Carajos, collected by Prof. J. Stanley Gardiner, × 2 (B.M.); 115, proximal pinnules of the specimen shown in fig. 114, × 2 (B.M.).

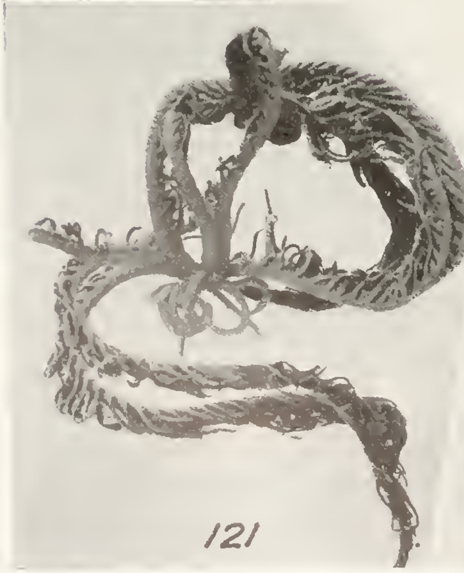
116, 117, *Decametra mylitta:* 116, Specimen from *Siboga* station 99, × 2 (Amsterdam Mus.); 117, specimen from *Siboga* station 99, × 2 (U.S.N.M., E. 388).

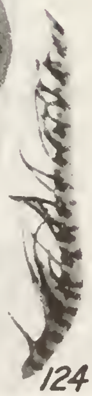

118

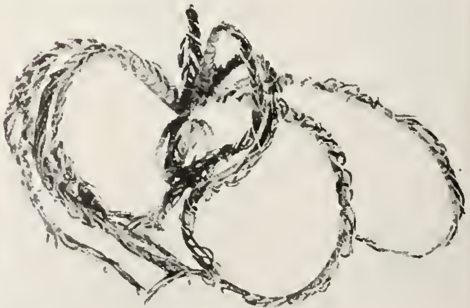

122


119
120


123


121


124


125

118, *Decametra mylitta:* Specimen from *Siboga* station 99, × 2 (U.S.N.M., E. 388).

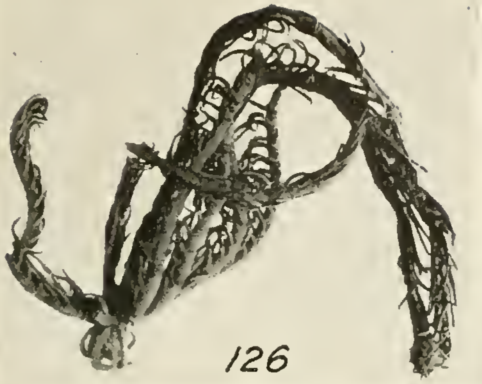
119, 120, *Decametra taprobanes:* 119, The type specimen from off Colombo Light House, Ceylon, in 48 meters (I.M.); 120, proximal pinnules of a specimen from off Colombo Light House, Ceylon, in 48 meters, × 2 (U.S.N.M., 35279).

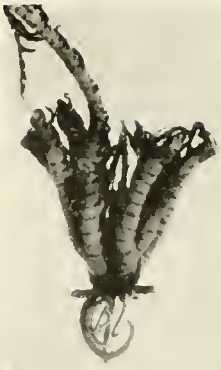
121, *Decametra studeri:* The type specimen from Dirk Hartog Island, Western Australia, in 13 meters (Berl. Mus.).

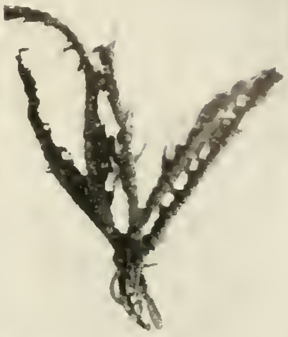
122, *Decametra mollis:* The type specimen from ?Kurrachi (I.M.).

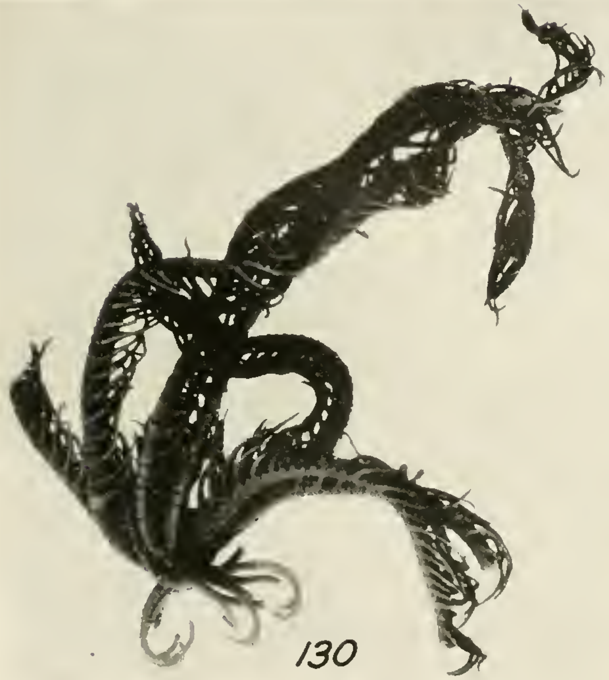
123, 124, *Decametra tigrina:* 123, Specimen from Kagoshima Bay, Japan, × 2 (U.S.N.M., 3033); 124, proximal pinnules of a specimen from Kagoshima Bay, × 2 (U.S.N.M., 3033).

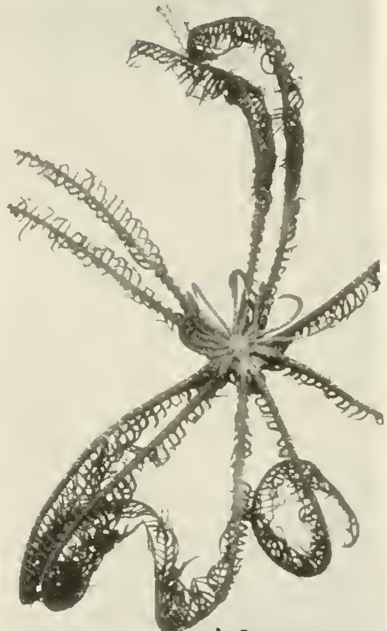
125, *Decametra informis:* Specimen from Sipankot in 3–6 meters, collected by the *Willebrord Snellius* (L.M.).

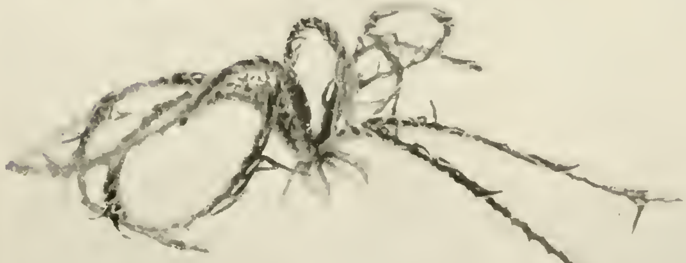

126

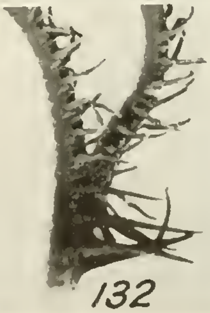

127


128


130


129


131


132

126, 127, *Decametra modica:* 126, The type specimen of *D. möbiusi* from Mauritius, × 2 (Berl. Mus.); 127, specimen from Bagamoyo, Tanganyika Territory, × 3 (U.S.N.M., 35385).

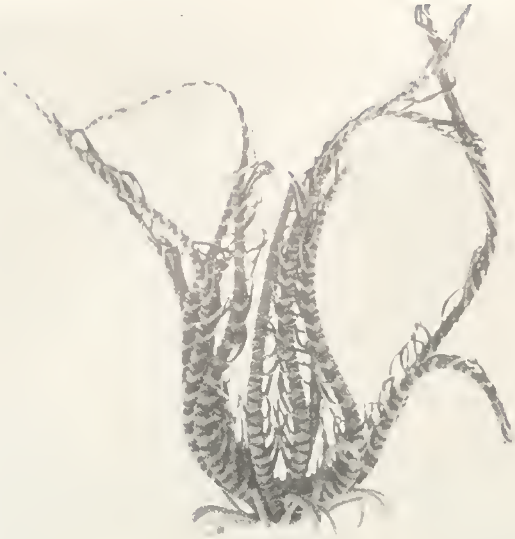
128, *Decametra brevicirra:* Specimen from 1 mile east of the Terribles in 24 meters, × 3 (U.S.N.M., 35370).

129, *Decametra laevipinna:* Specimen from Obi Latoe, collected by the *Willebrord Snellius* (L.M.).

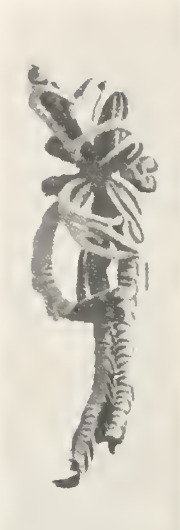
130, *Decametra taprobanes:* Specimen from off Colombo Light House, Ceylon, in 48 meters, × 2 (U.S.N.M., 35279).

131, *Decametra minima:* Specimen from *Siboga* station 117, × 3 (Amsterdam Mus.).

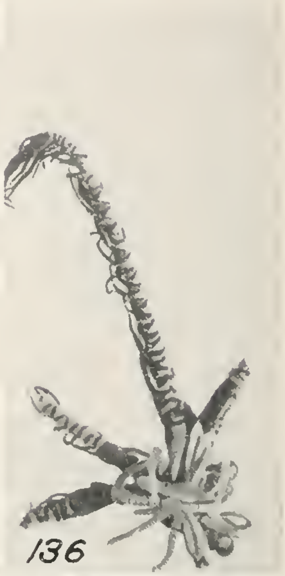
132, *Decametra laevipinna:* Proximal pinnules of the type specimen from *Siboga* station 214 (Salayer), × 3 (Amsterdam Mus.).



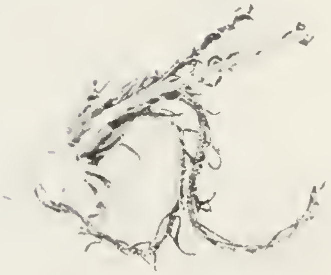
133



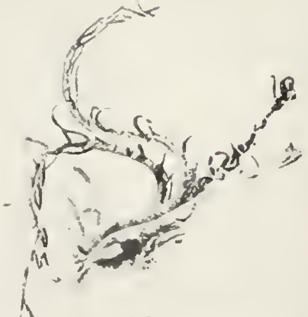
134



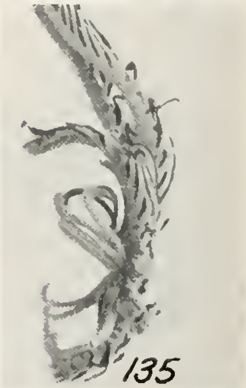
136



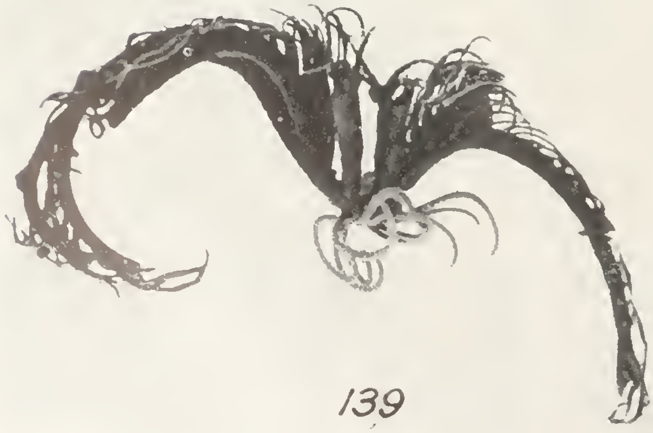
137



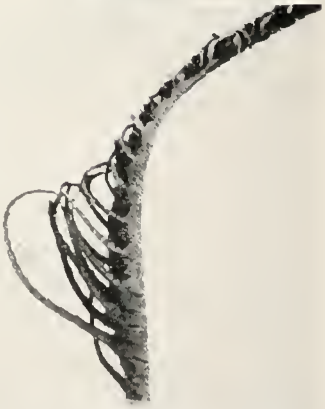
138



135

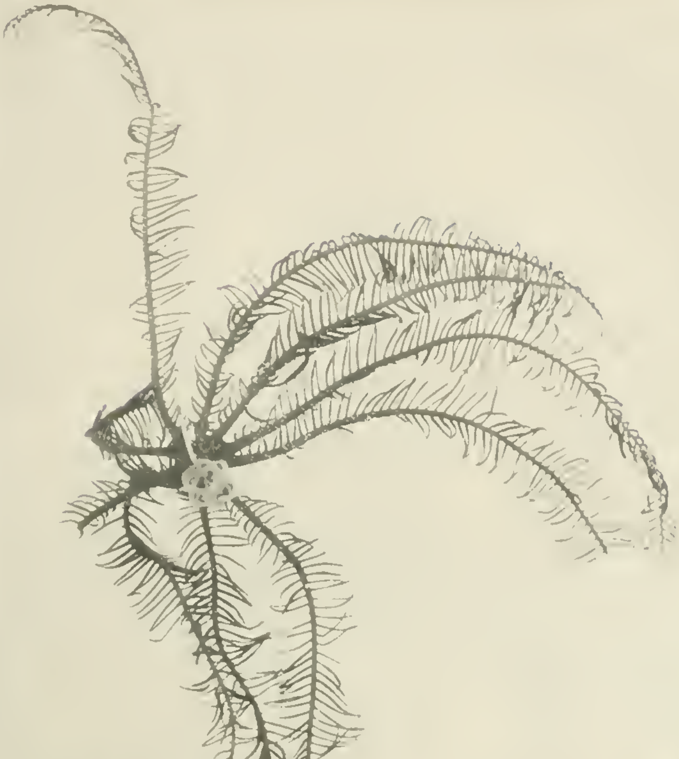


139

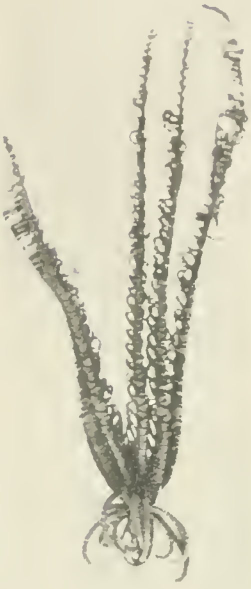


140

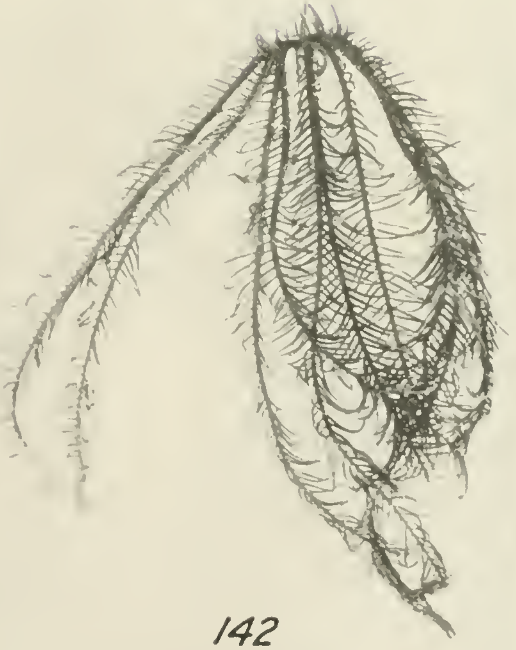
133, *Decametra tigrina:* The type specimen from Kagoshima Bay, Japan, × 2 (U.S.N.M., 22642).
134, 135, *Iconometra japonica:* The type specimen from Japan, × 2 (Berl. Mus.).
136, *Oligometra serripinna* var. *occidentalis:* The type specimen from Mauritius, × 2 (Berl. Mus.).
137, 138, *Clarkometra elegans:* Specimen from *Willibrord Snellius* station 60*, × 3 (L.M.).
139, 140, *Decametra chadwicki:* 139, The type specimen from Suez Bay in 18 meters, × 2 (U.S.N.M., 27509); 140, proximal pinnules of the type specimen shown in fig. 139, × 3 (U.S.N.M., 27509).



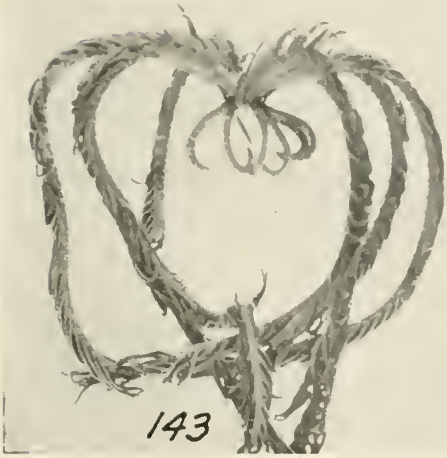
141



144



142

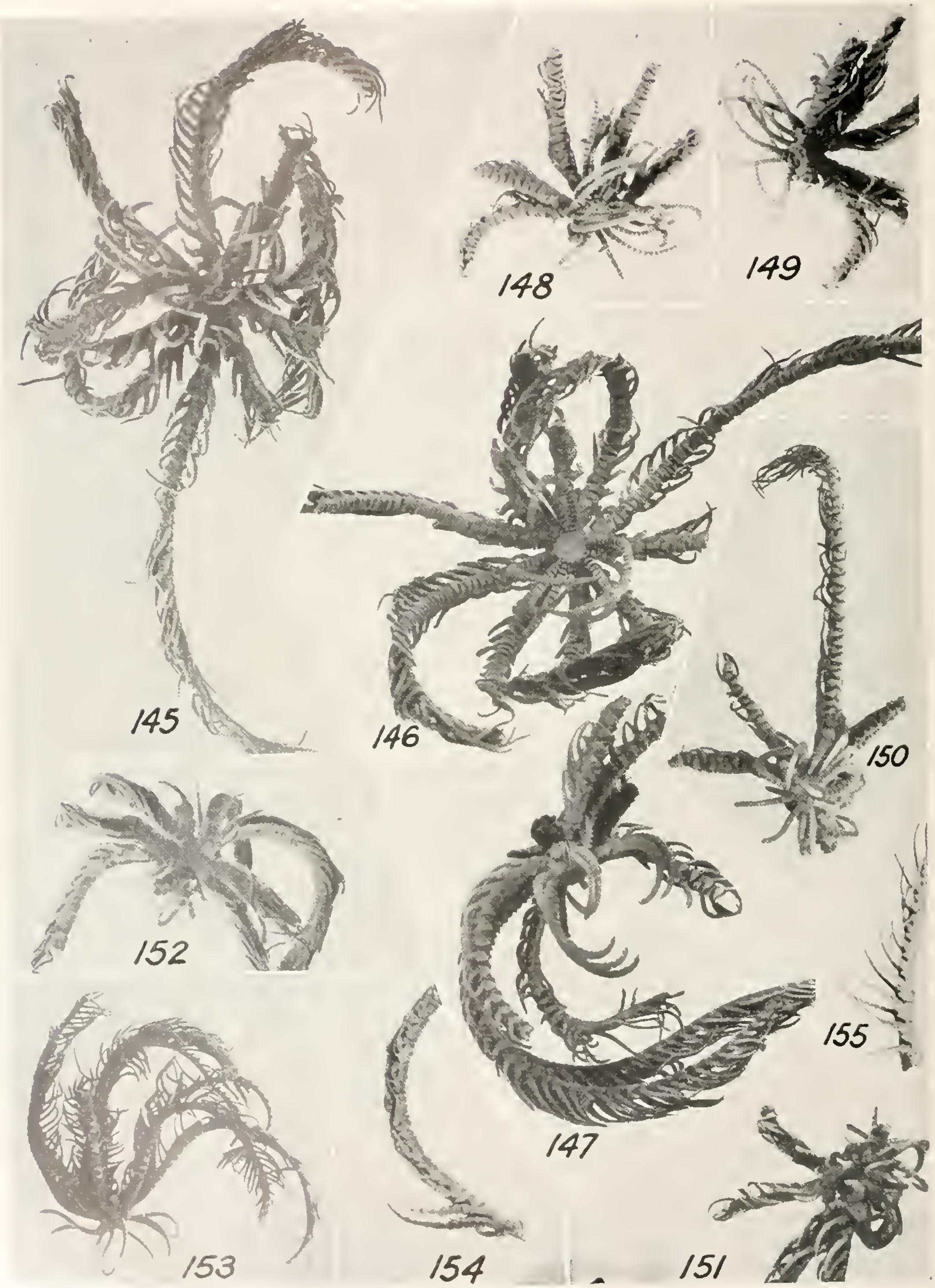


143

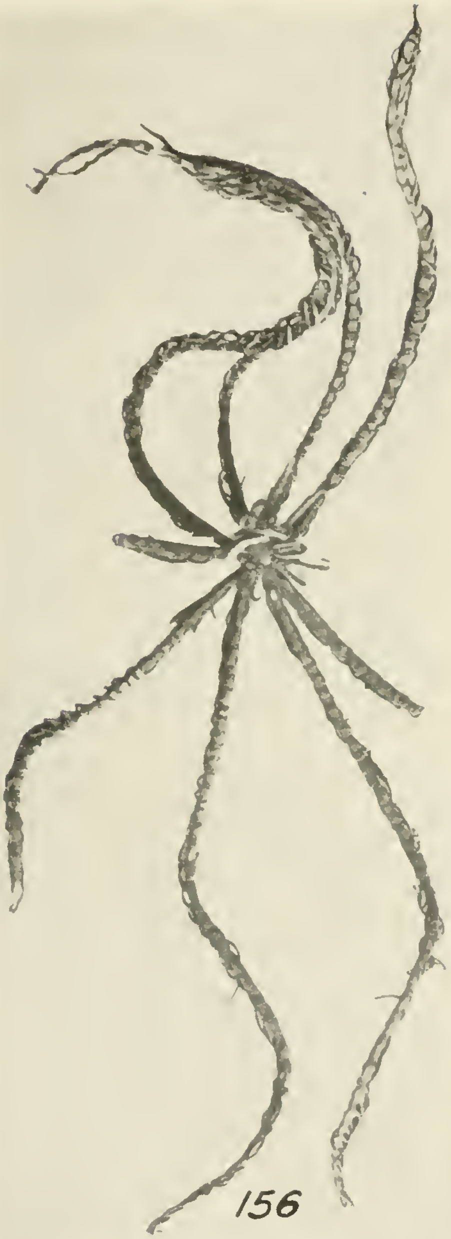
141, 142, *Oligometra serripinna* var. *macrobrachius:* Specimen from Ternate in 2-4 meters, collected by the *Willibrord Snellius* (L.M.).

143, *Oligometra serripinna serripinna.* Specimen from the Ganjam coast of India in 43-55 meters, collected by the *Golden Crown* (U.S.N.M., 35340).

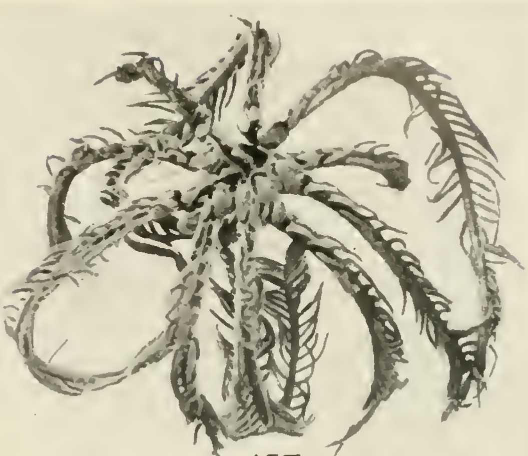
144, *Oligometra serripinna chinensis:* Specimen from Amoy (U.S.N.M., E. 3100)



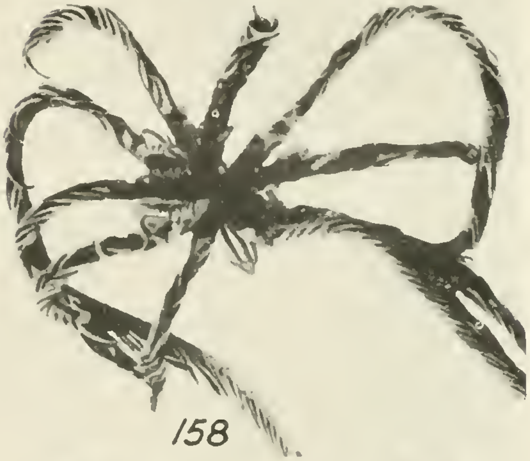
145–147, *Oligometra serripinna* var. *imbricata:* The type specimen from ?Tranquebar, India, × 2 (C.M.).
148, 149, *Oligometra serripinna* var. *erinacea:* Specimen from northeast of Octaria Bay, × 2 (U.S.N.M., E. 3272).
150, 151, *Oligometra serripinna* var. *occidentalis:* The type specimen from Mauritius, × 2 (Berl. Mus.).
152, *Oligometra serripinna chinensis* from Fuchow, × 2 (H.M.).
153–155, *Oligometra serripinna serripinna:* 153, Specimen from the Tonga Islands (H.M.); 154, proximal pinnules of a specimen from the Ganjam coast of India in 49–55 meters, × 3 (U.S.N.M., 35340); 155, proximal pinnules of a specimen from the Danish Expedition to the Kei Islands station 14, × 2 (U.S.N.M., E. 3148).



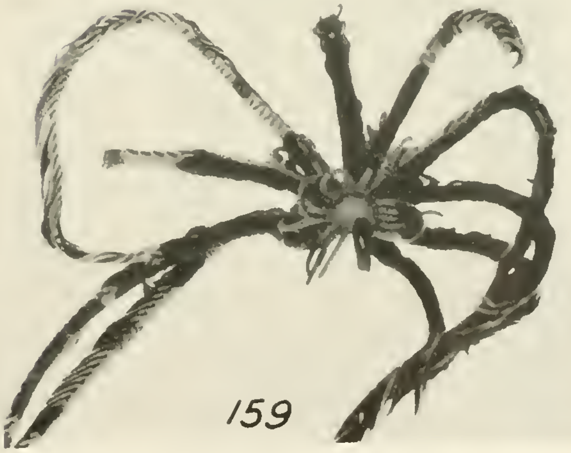
156



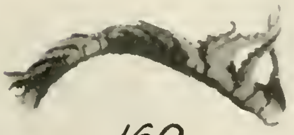
157



158



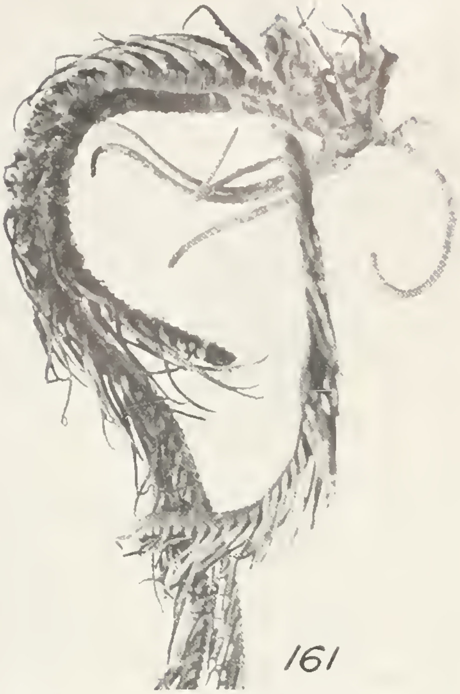
159



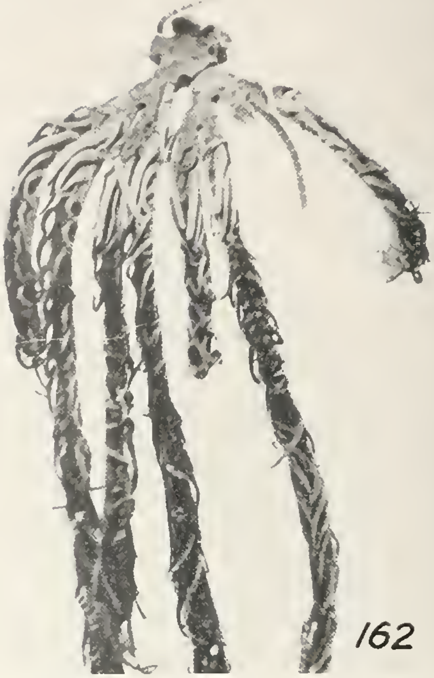
160

156, *Oligometra serripinna serripinna:* Specimen from Muhlos, Maldive Archipelago, × 2 (B.M.).

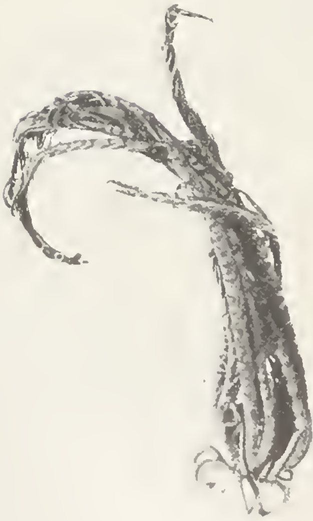
157–160, *Oligometra carpenteri:* 157, Specimen from *Siboga* station 273, × 2 (Amsterdam Mus.); 158, 159, specimen from Port Curtis, Queensland, × 2 (U.S.N.M., 35308); 160, proximal pinnules of a specimen from Port Curtis, Queensland, × 3 (U.S.N.M., 35308).



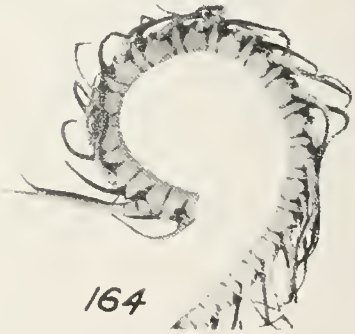
161



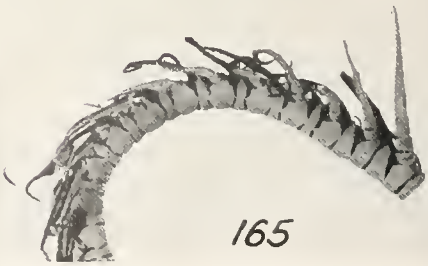
162



163

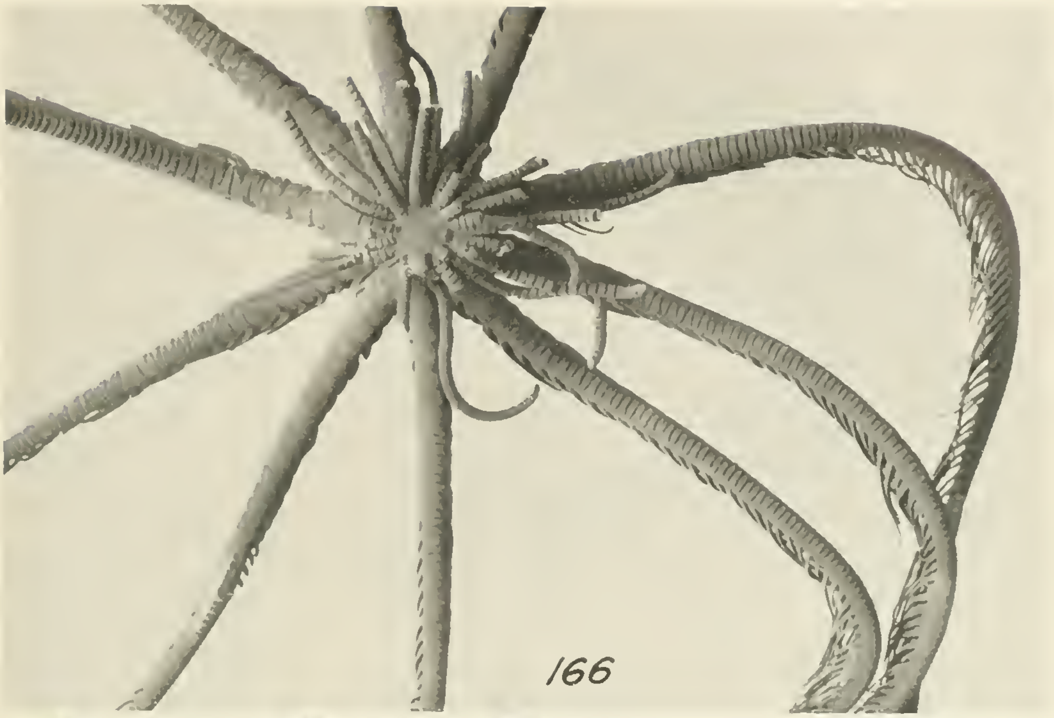


164

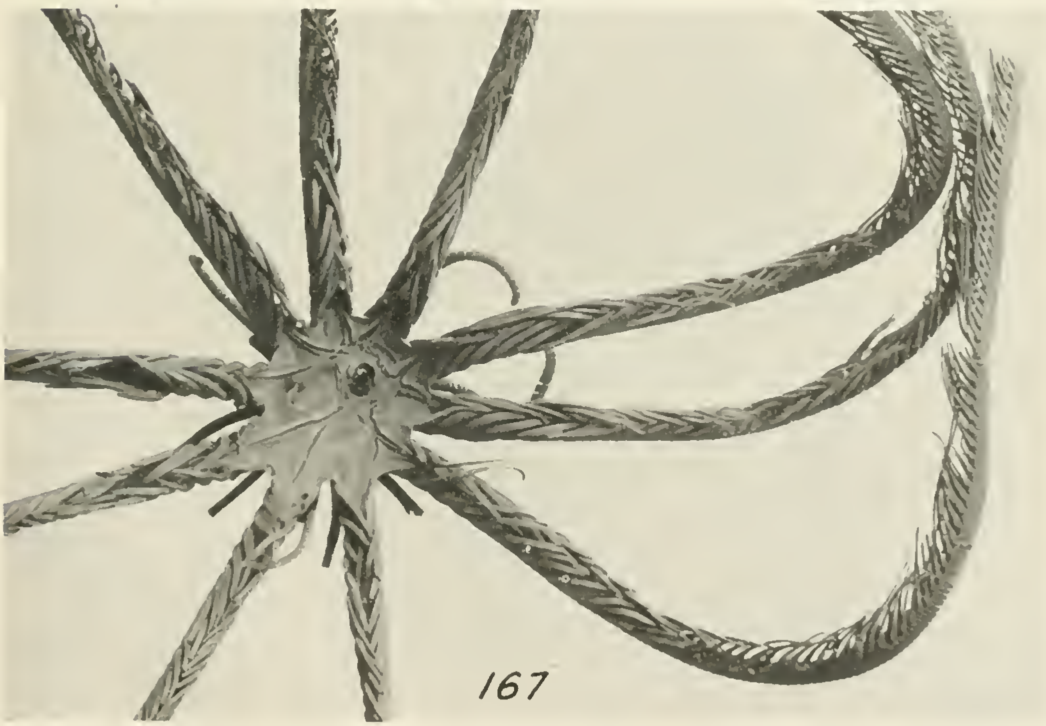


165

161, *Colobometra arabica:* The type specimen from *Mabahiss* station 10, × 2 (B.M.).
162, *Stephanometra spicata:* Specimen from *Mabahiss* station 10, × 2 (B.M.).
163, *Oligometra serripinna* var. *occidentalis* from *Mabahiss* station 27, × 2 (B.M.).
164, 165, *Stephananometra indica indica:* Proximal pinnules of specimens from *Mabahiss* station M.B.*d.*, × 2 (B.M.).

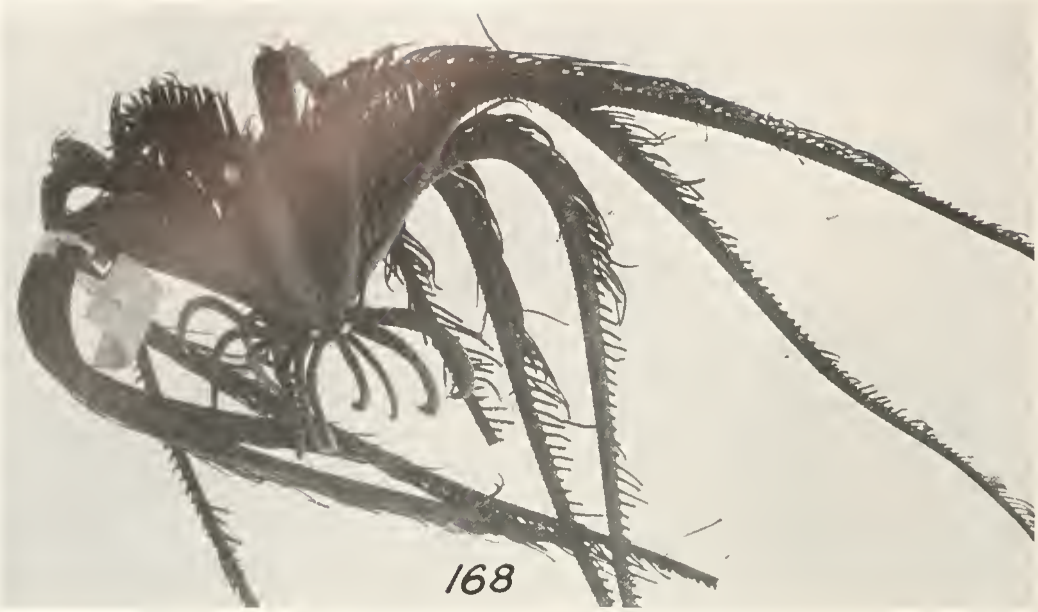


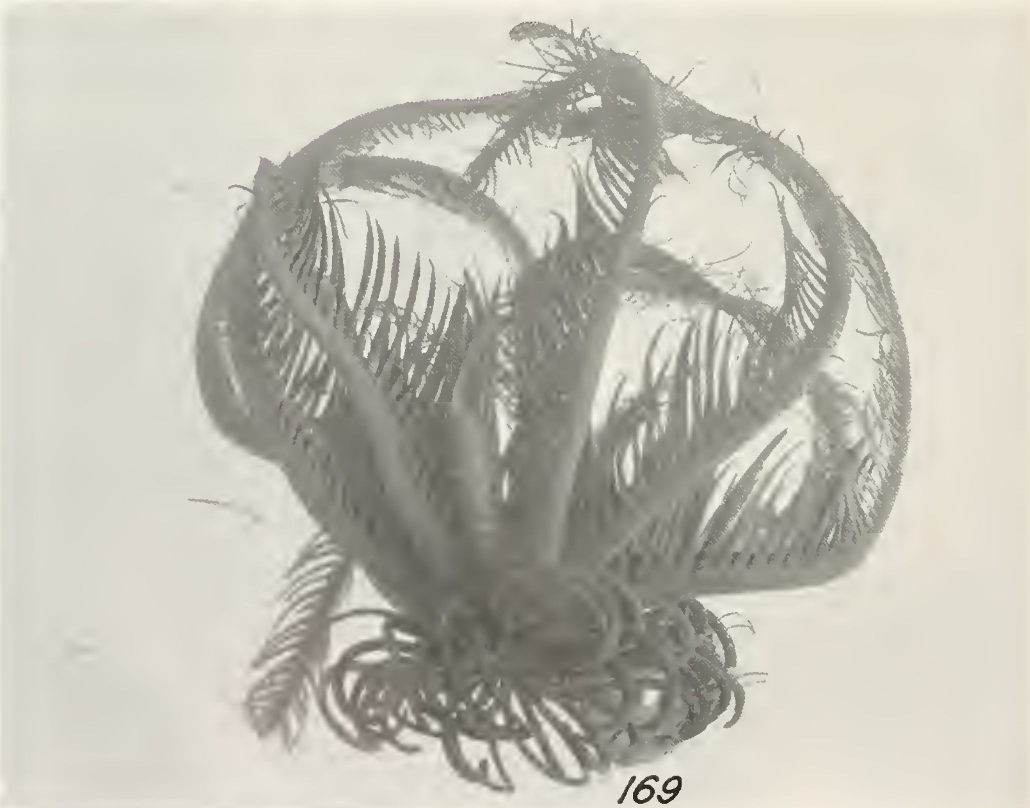
166



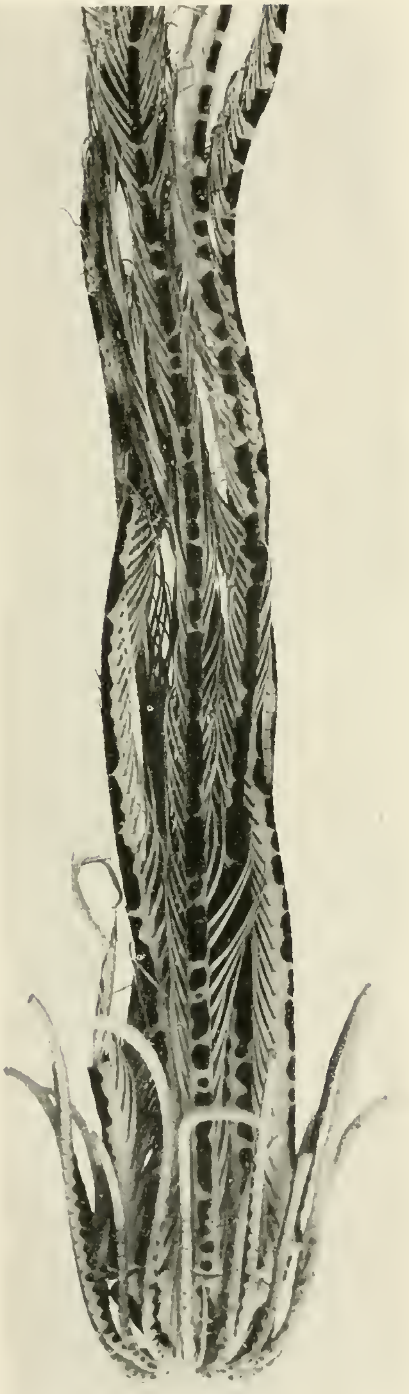
167

166, 167. *Tropiometra afra afra:* Specimen from the "South Pacific" (U.S.N.M., 4015).

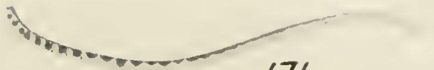

168


169

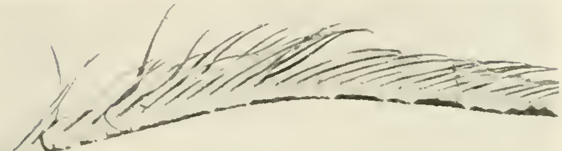
168. *Tropiometra afra afra.* Specimen from Bowen, Queensland (C.M.).
169, *Tropiometra afra macrodiscus:* Specimen from near Misaki, Japan, 10–20 meters (Munich Mus.).



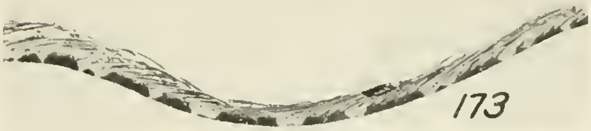
170



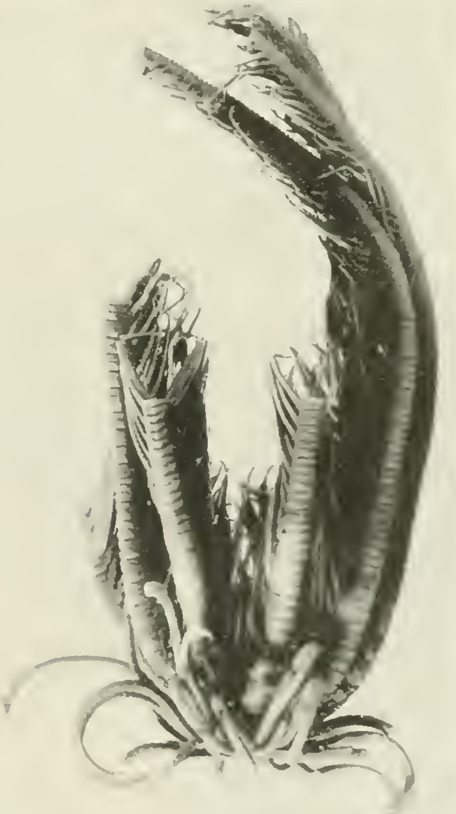
171



172



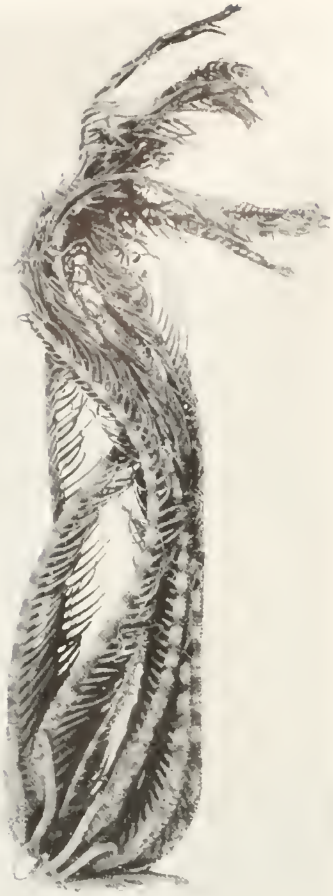
173



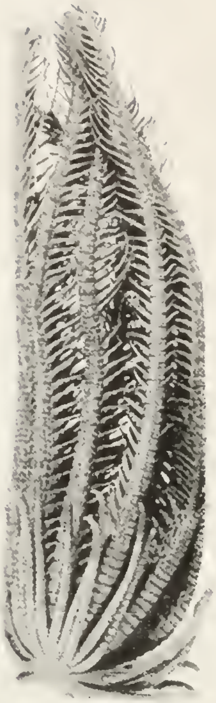
174

170–173, *Tropiometra magnifica:* The type specimen from *Mabahiss* station 24 (B.M.). 170, Lateral view; 171, a cirrus; 172, proximal pinnules; 173, distal pinnules.

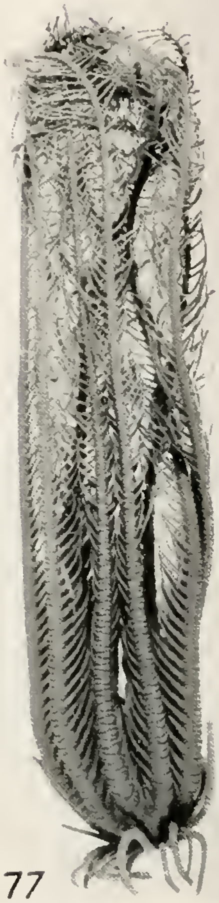
174, *Tropiometra afra afra:* Specimen from *Siboga* station 164 (Amsterdam Mus.).



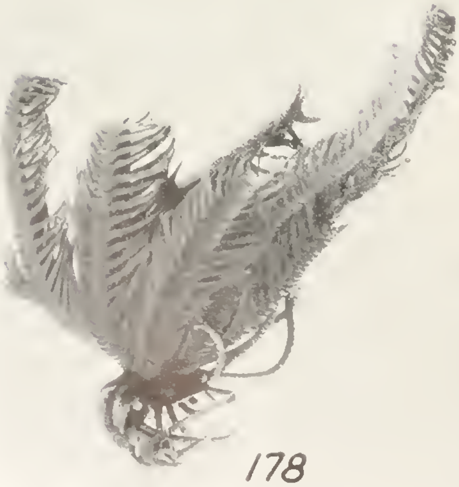
175



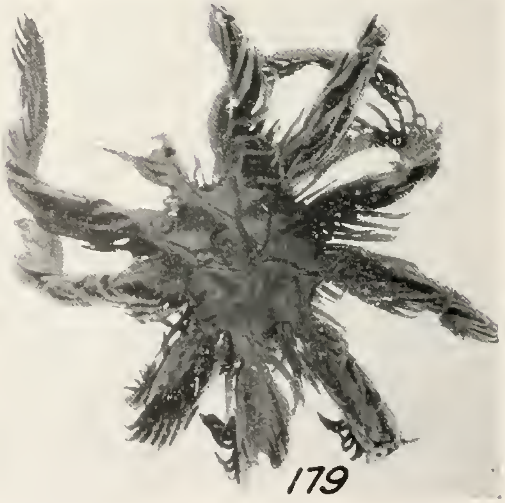
176



177

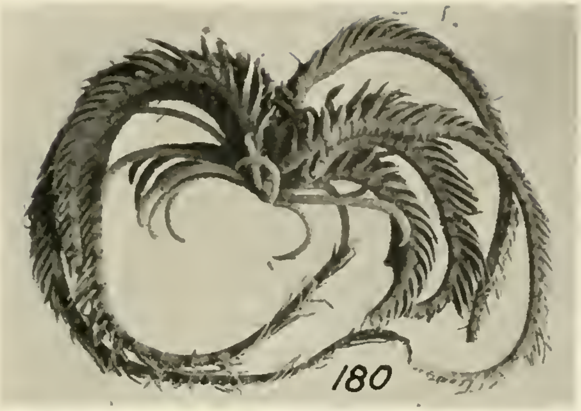


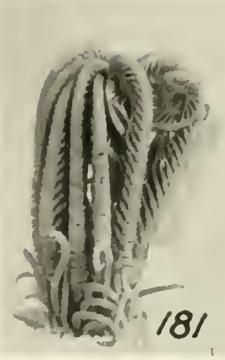
178

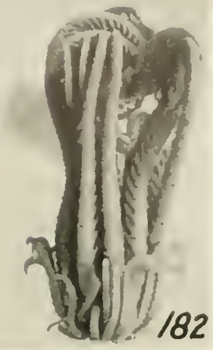


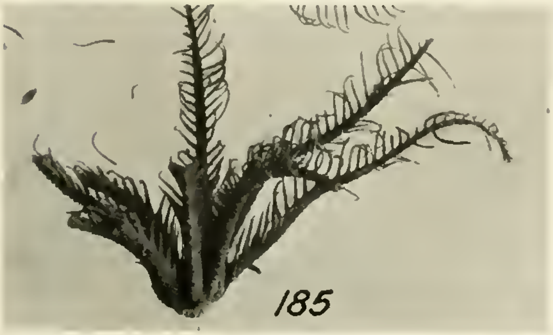
179

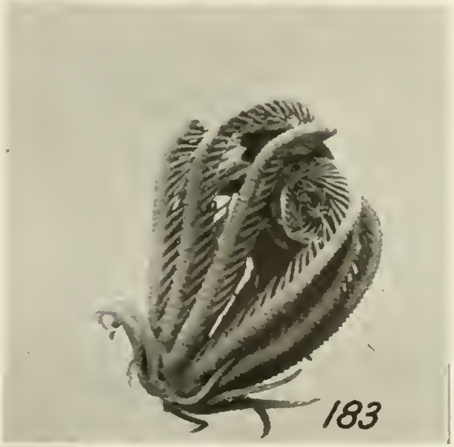
175–179, *Tropiometra carinata clarki:* 175–177, Specimens from Madras Harbor, India, 9 meters (I.M.); 178, 179, from near Mandapam, 4–7 meters (I.M.).

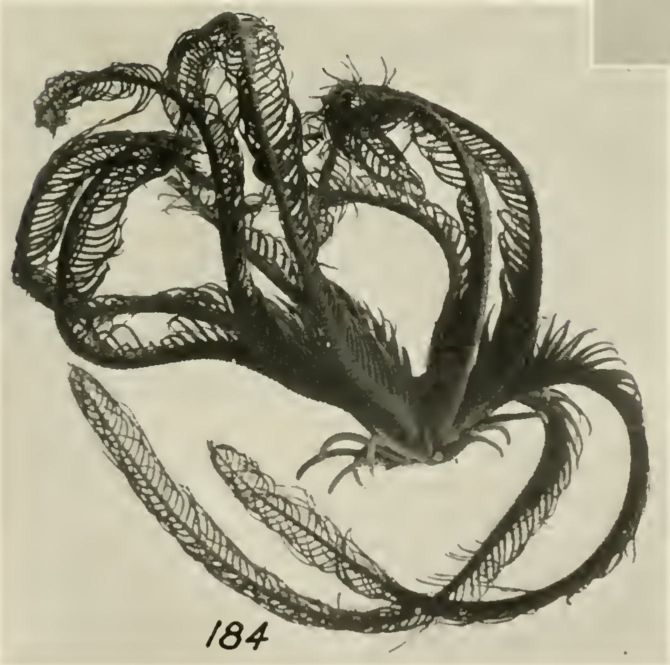

180

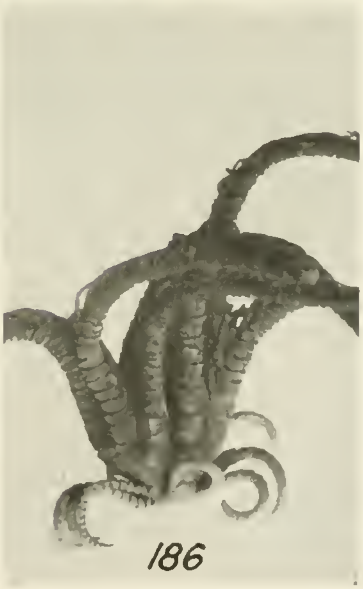

181


182


185


183

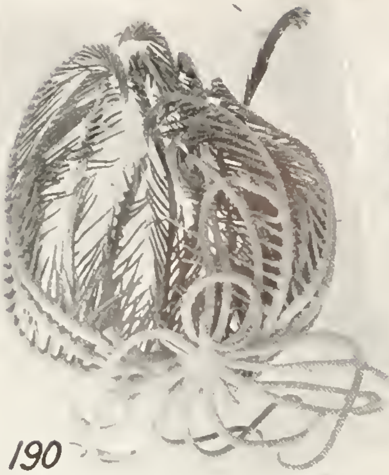

184

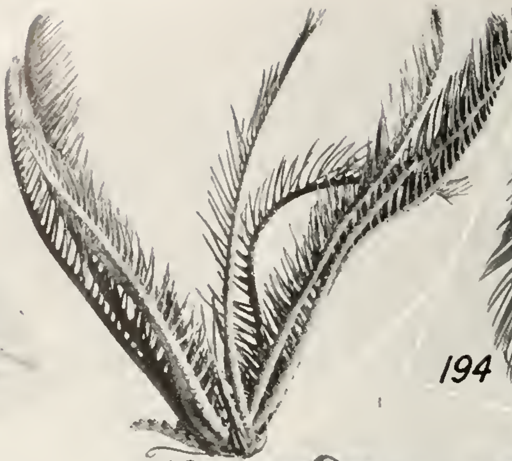

186

180–182, *Tropiometra carinata clarki:* 180, Specimen from "Eastern Asia" (Berl. Mus., 5336); 181, 182, no locality (C.M.).

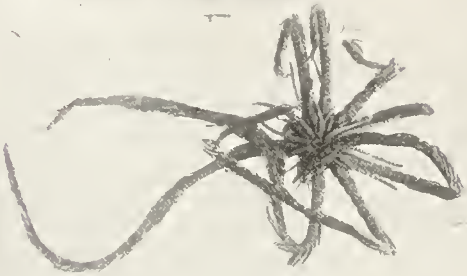
183, 184, *Tropiometra carinata carinata:* 183, Specimen from Mauritius (Berl. Mus., 1038); 184, from Rio de Janeiro (C.M.).

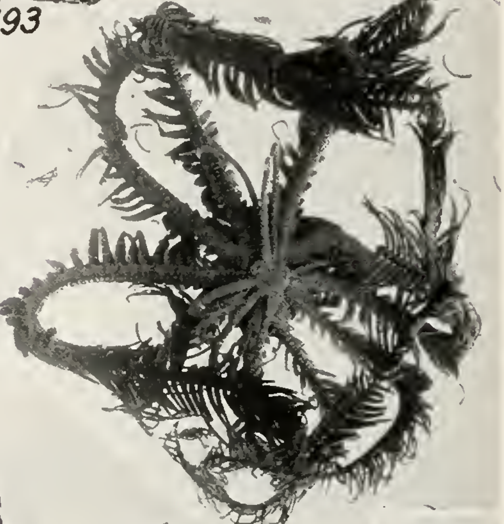
185, 186, *Tropiometra carinata audouini:* 185, The type specimen from Erg Tor (Berl. Mus., 5602); 186, specimen from Hurghada, × 2 (B.M.).

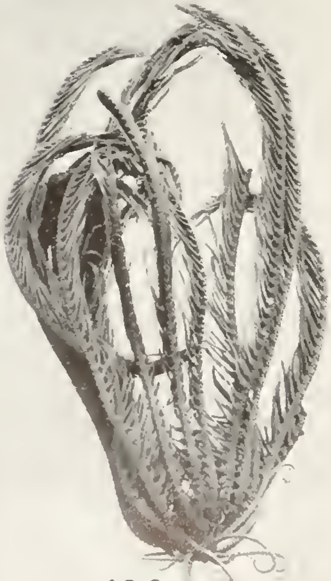

190

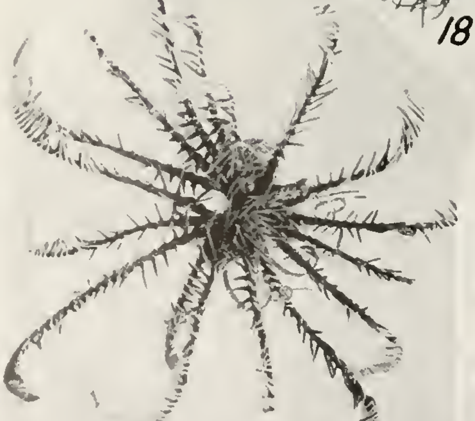

193

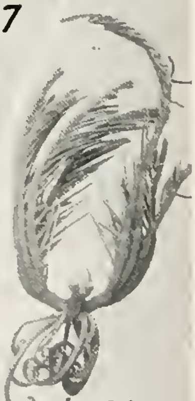
194


188


187


189


192


191

187, 188, *Tropiometra carinata carinata:* Specimens from Rio de Janeiro (C.M.).

189, *Gephyrometra versicolor:* The type specimen from *Albatross* station 4884 (U.S.N.M., 22620).

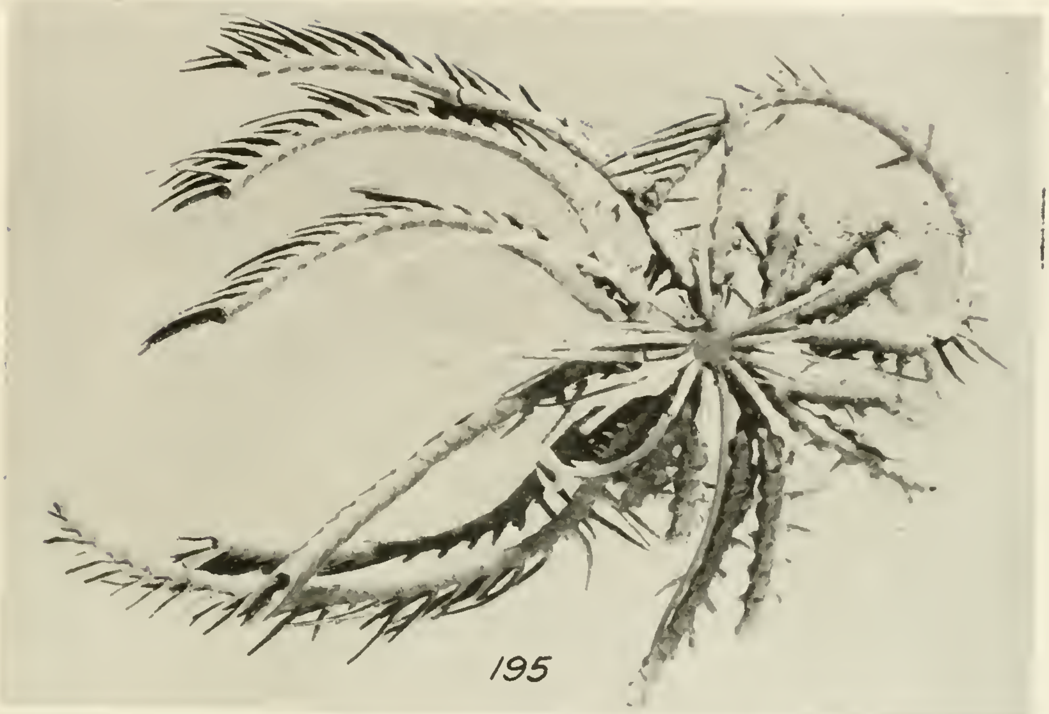
190, *Neometra gorgonia:* Specimen from between Fremantle and Geraldton, Western Australia, 146–219 meters (W.A.M.).

191, *Neometra conaminis:* Specimen from between Fremantle and Geraldton, Western Australia, 146–219 meters (W.A.M.).

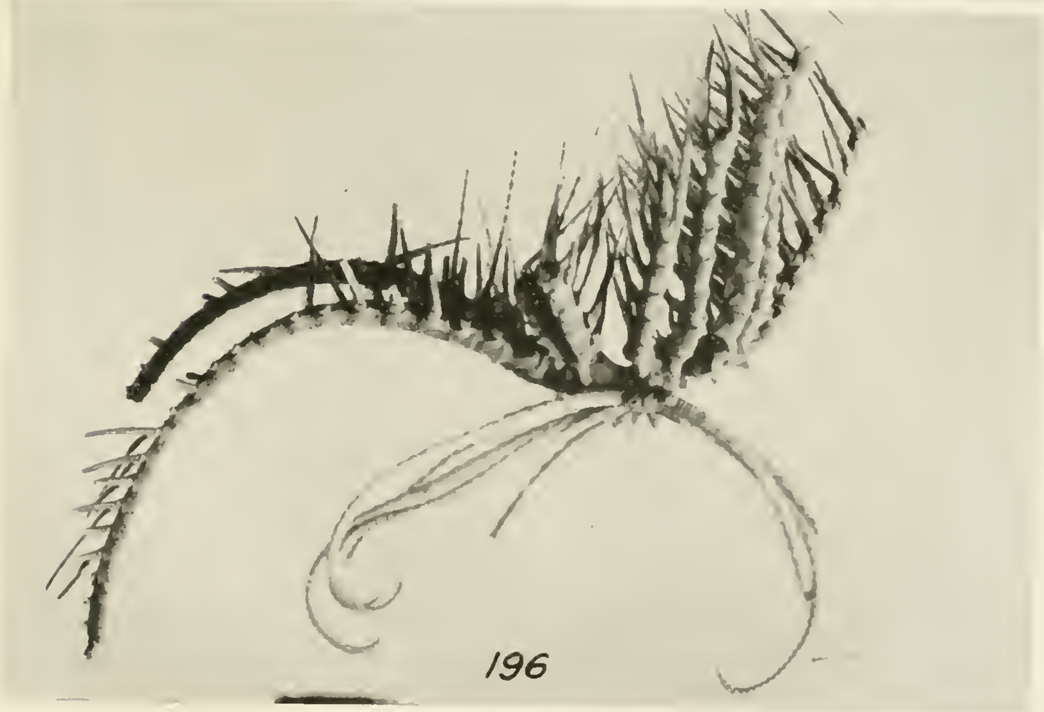
192, *Neometra multicolor:* Specimen from Japan (U.S.N.M.).

193, *Calometra callista:* The type specimen from *Albatross* station 4903 (U.S.N.M., 22624).

194, *Asterometra anthus:* Pinnules of the type specimen of *A. lepida*, from the Formosa Channel, 64 meters (C.M.).

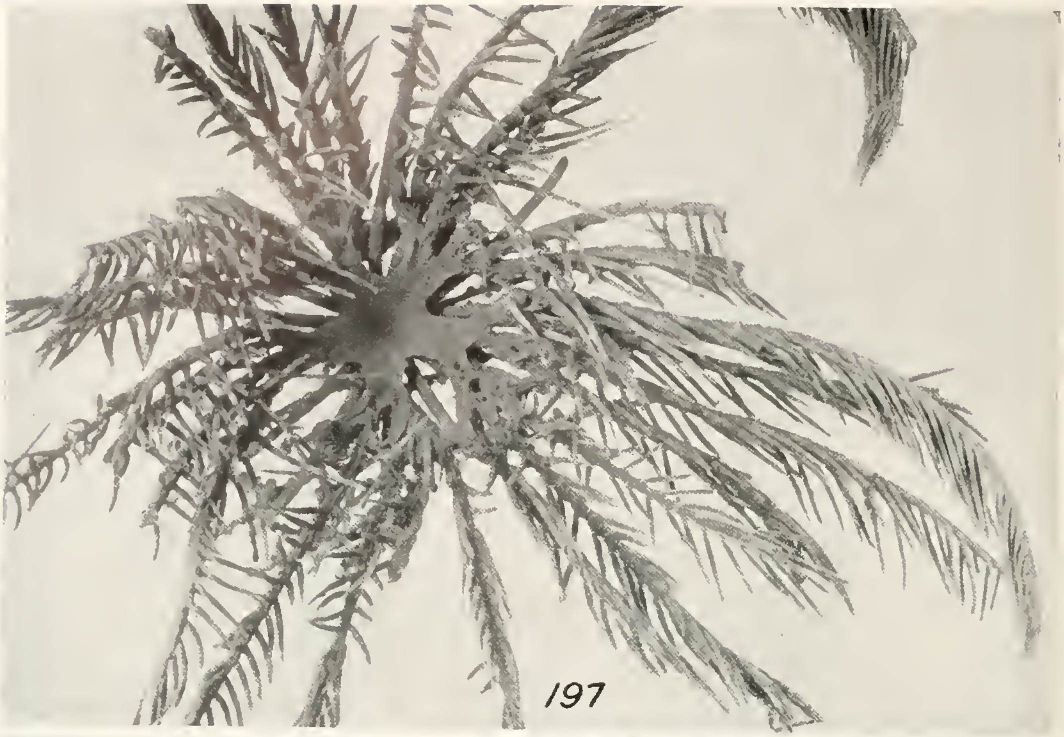


195

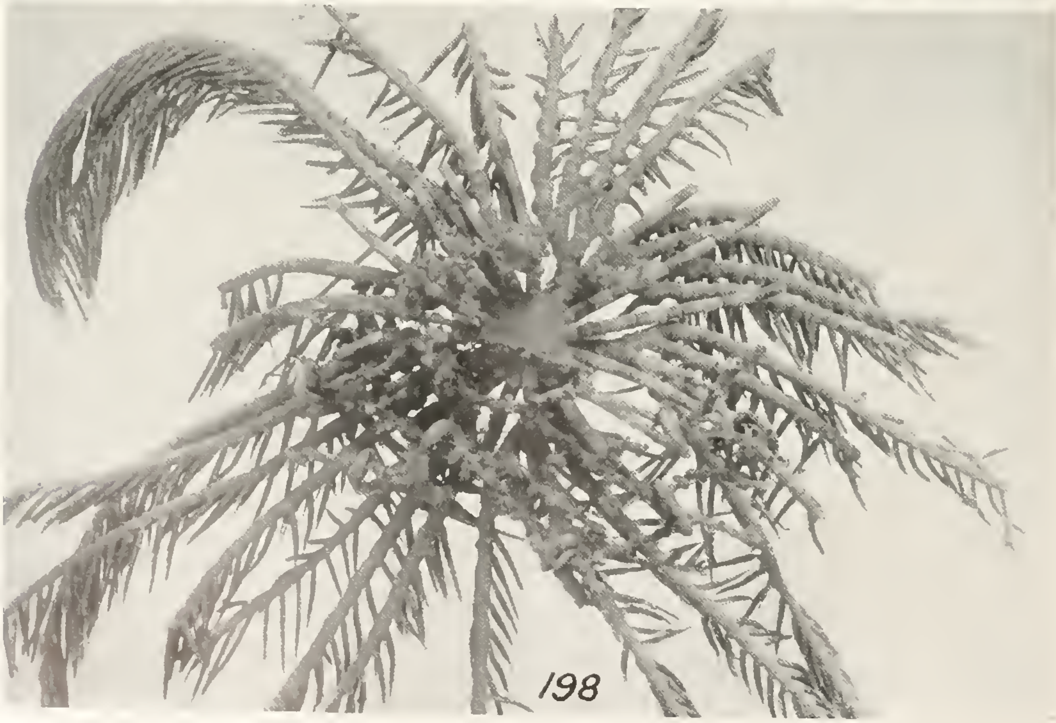


196

195, 196, *Neometra diana:* The type specimen from *Siboga* station 294, × 2 (Amsterdam Mus.).

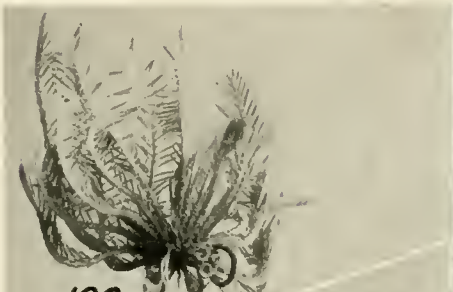


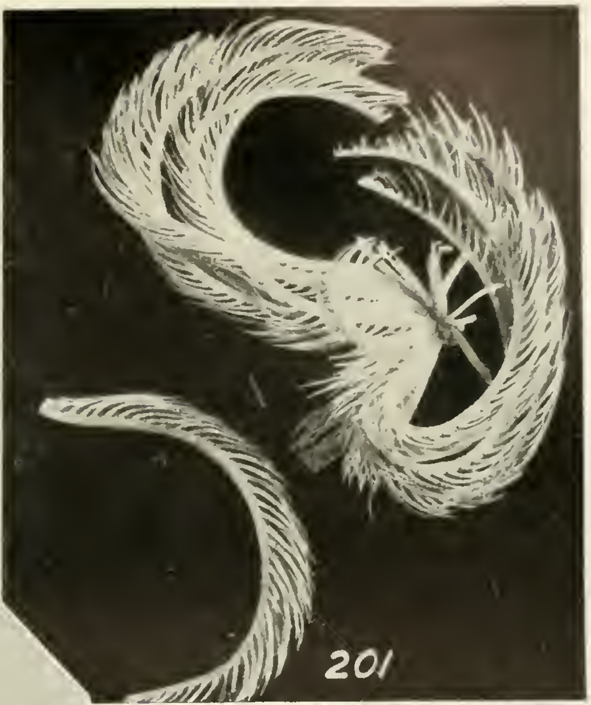
197

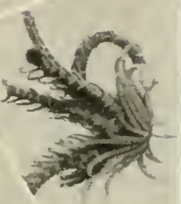


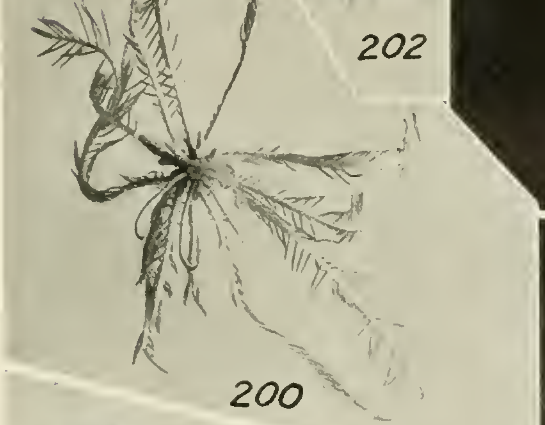
198

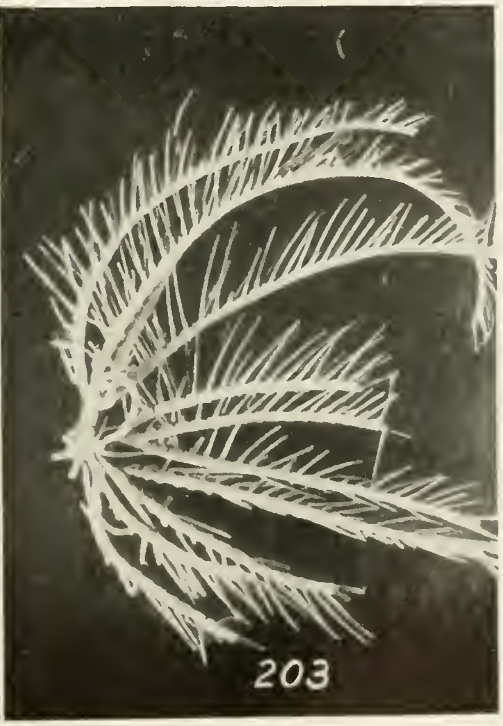
197, 198, *Neometra sibogae:* A cotype from *Siboga* station 305, × 2 (Amsterdam Mus.).

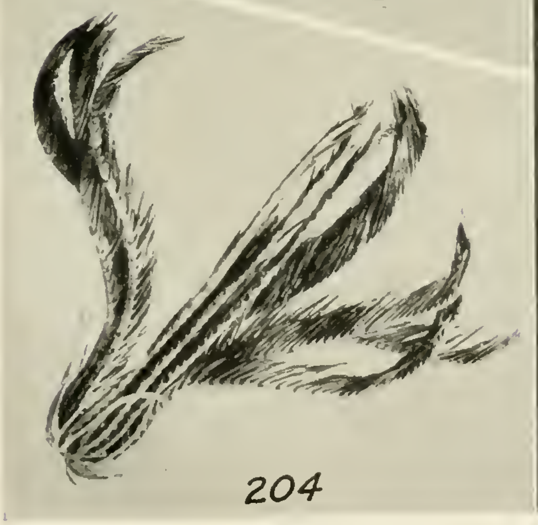

199


201


202


200


203


204

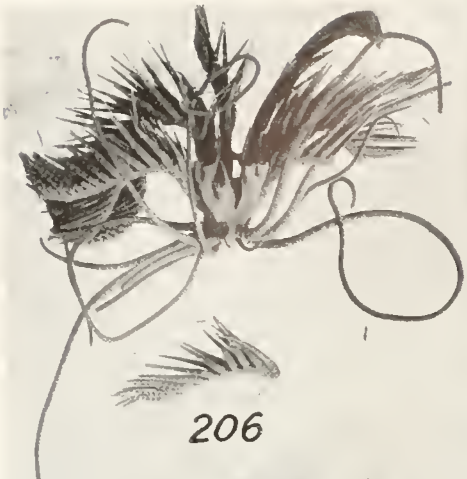
199, 200, *Pectinometra flavopurpurea:* Specimens from Japan (U.S.N.M.).

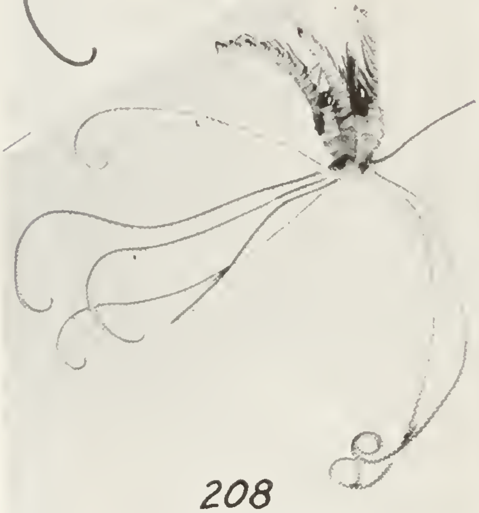
201, *Pectinometra magnifica:* The type specimen from *Investigator* station 236*a* (I.M.).

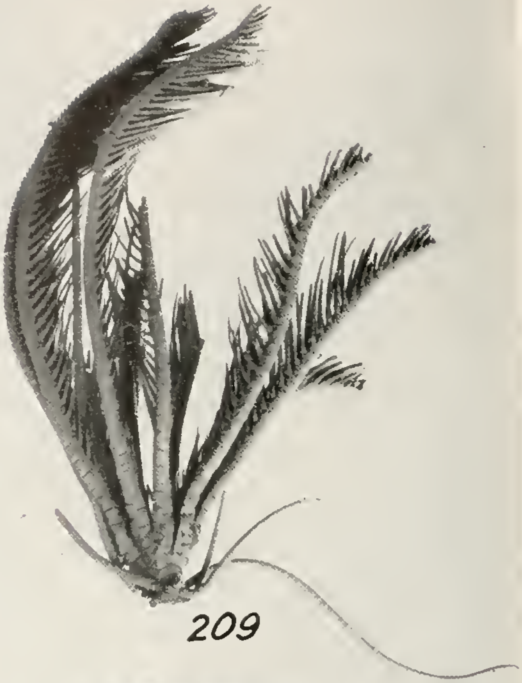
202, *Tropiometra carinata audouini:* Specimen from Ras-el-Millan (Berl. Mus., 5603).

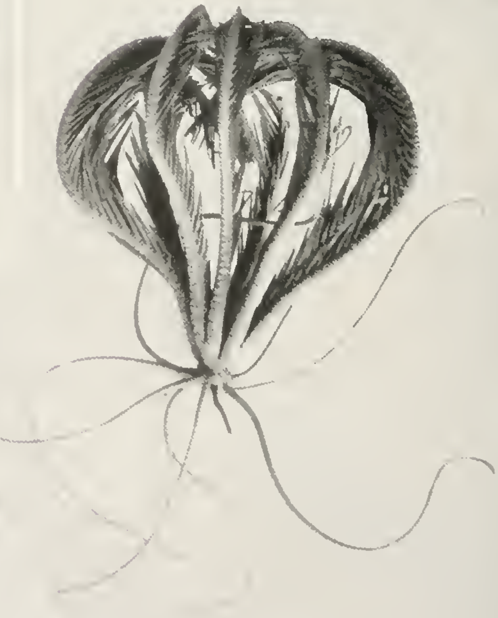
203, *Neometra spinosissima:* The type specimen from *Investigator* station 236*a* (I.M.).

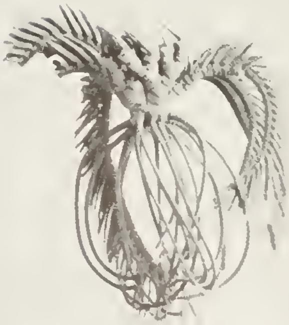
204, *Gephyrometra versicolor:* Type specimen of *Antedon propinqua*, from *Albatross* station 4895 (U.S.N.M., 22621).


206


208


209


210

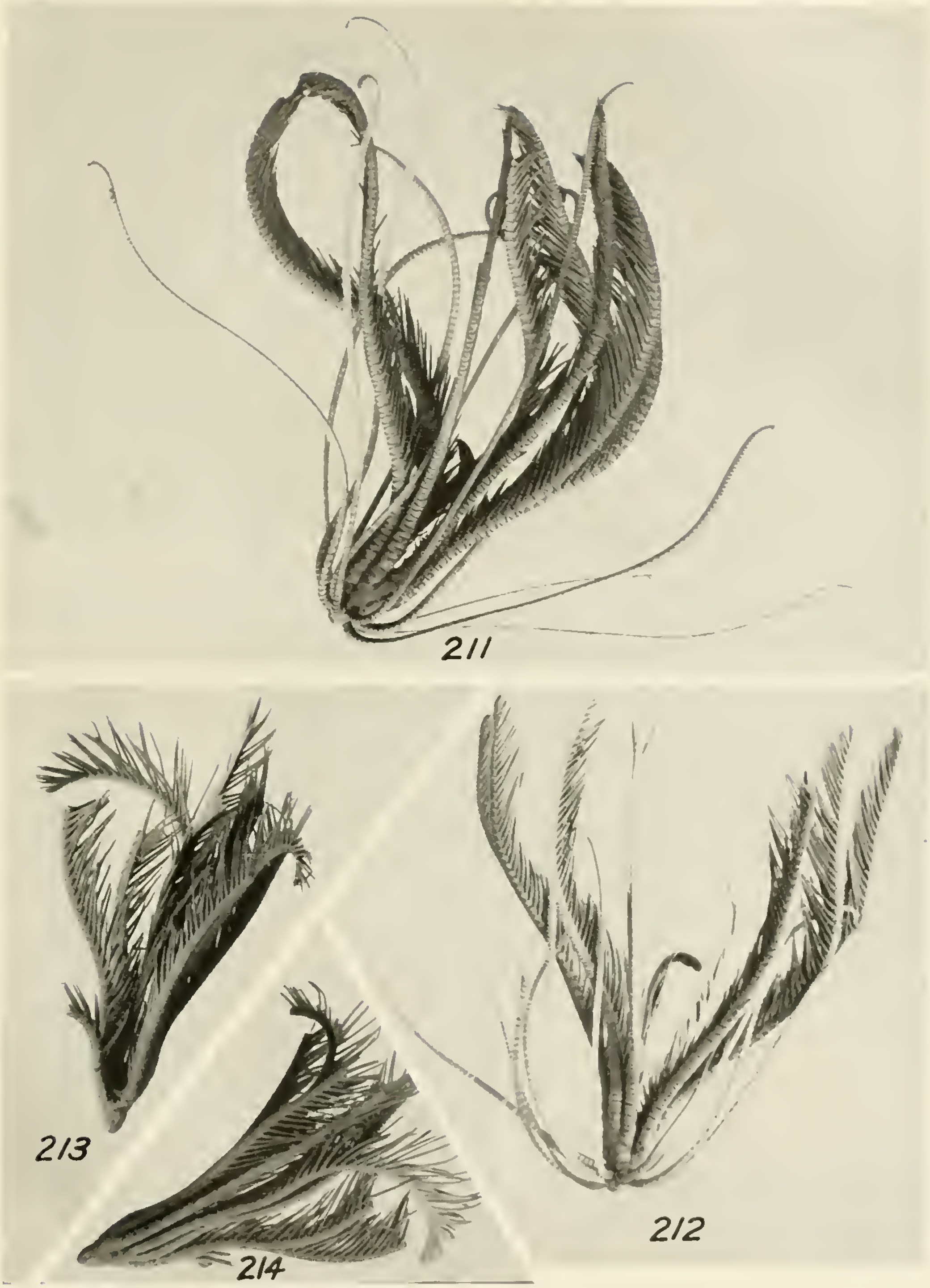

207

206, *Ptilometra macronema:* Type specimen of *P. dorcadis* from Dirk Hartog Island, Western Australia, 16 meters (Berl. Mus., 2964).

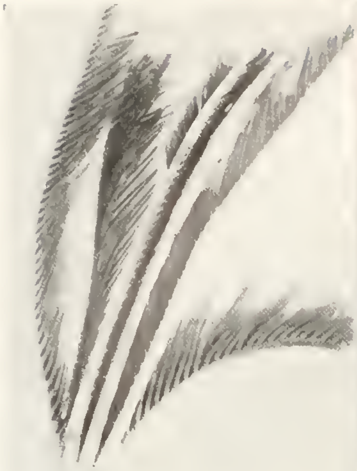
207, *Ptilometra australis:* Specimen from Port Stephens, New South Wales (U.S.N.M.).

208, *Asterometra mirifica*, Specimen from Rotti Strait, 183 meters (B.M.).

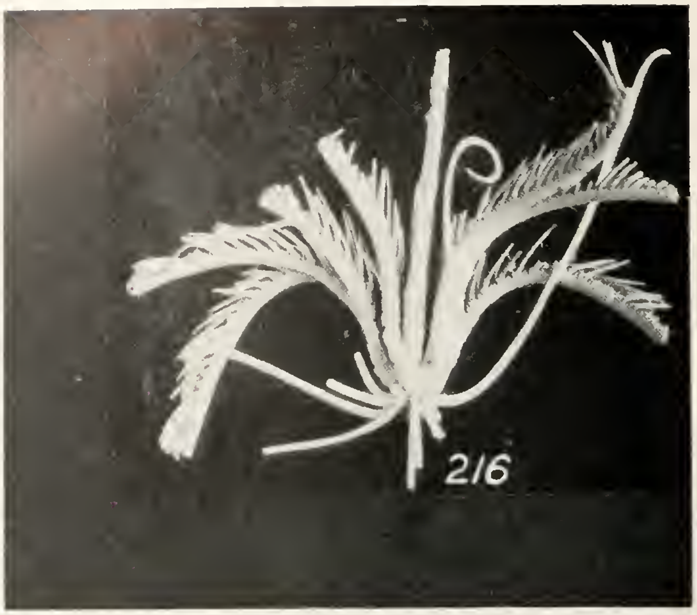
209, 210, *Asterometra cristata:* Specimens from off Cape Padaran, southern Annam, 146 meters (B.M.).



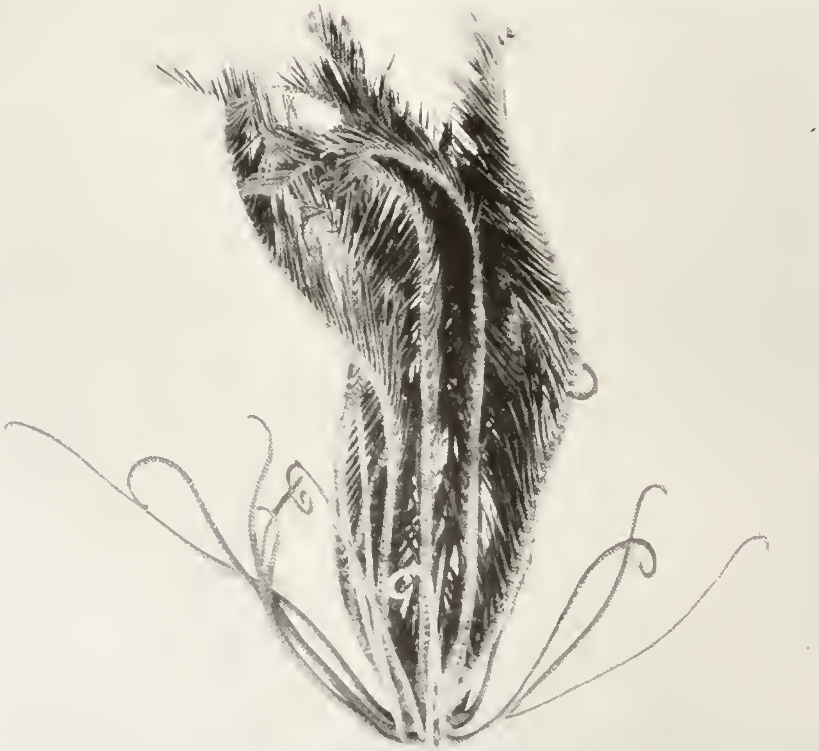
211, *Asterometra macropoda:* Specimen from *Albatross* station 4935 (U.S.N.M., 22626).
212–214, *Asterometra anthus:* 212, The type specimen from *Albatross* station 4936 (U.S.N.M., 22625); 213, 214, the type specimen of *A. lepida*, from the Formosa Channel, 64 meters (C.M.).



215

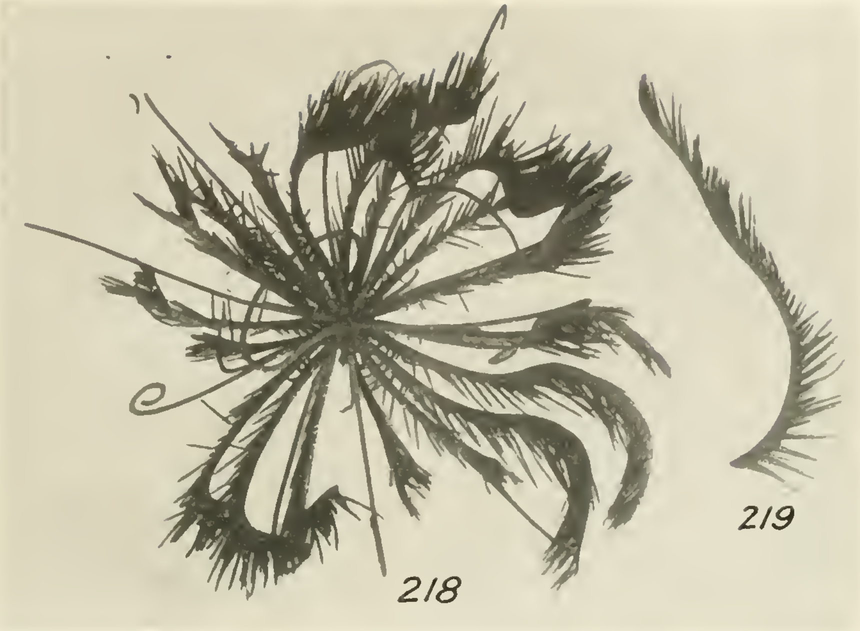


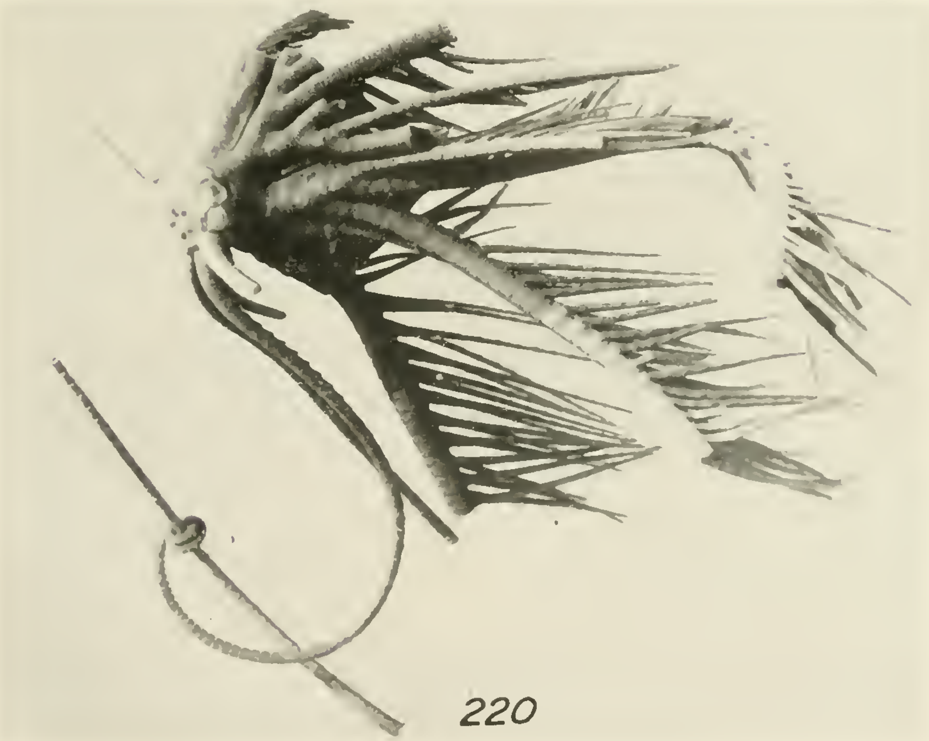
216



217

215, *Asterometra anthus:* The type specimen of *A. acerba*, from the Sahul Bank (I.M.).
216, *Asterometra mirifica:* The type specimen from the Sahul Bank (I.M.).
217, *Asterometra cristata:* Specimen from *Willebrord Snellius* station 60* (L.M.).





218, 219, *Pterometra pulcherrima:* Specimen from *Investigator* station 387 (I.M.).

220. *Pterometra venusta.* Specimen from *Siboga* station 117, × 2 (Amsterdam Mus.).

INDEX

abbotti, Antedon, 27, 38, 42
  Cenometra, 28, 31, 42
  Himerometra, 27, 42
abotti, Cenometra, 28
acanthaster, Calometra, 363, 369, 370
  Neometra, 348, 356, *363*, 364, 368
acerba, Asterometra, 444, 456, 457, 458, 459
acoela, Antedon (Poecilometra), 385
Acoela group, 66, 346, 385
Actinometra, 75, 83, 259, 260, 324, 412
  carinata, 293
  parvicirra, 292, 293, 326
  solaris, 333, 334, 335
Adeona, 75
adeonae, Alecto, 62, 74
  Antedon, 6, 62, 75, 76, 289, 337, 340, 341
  Comatula, 61, 62, 63, 65, 71, 74, 75, 76
  Oligemetrides, 63
  Oligometra, 53, 55, 56, 62, 63, 67, 76, 77, 90, 102, 202, 209, 260
  Oligometrides, 6, 52, 58, *62*, 63, 74, 77, 90, 93, 97, 101, 102, 103, 104, 209; pl. 9, figs. 43, 44
adeonae form scabra, Oligometra, 63, 71, 72
adriani, Anthometra, 375, 421
adriatica, Antedon, 305, 306
aequipinna, Antedon, 156
afer, Antedon, 268, 271
afra, Antedon, 268, 271, 280
  Tropiometra, 261, 263, 264, 265, 268, 271, 272, 273, 274, 280, 281, 286, 288, 289, 331, 334
afra afra, Tropiometra, 265, *268*; pl. 31, figs. 166, 167; pl. 32, fig. 168; pl. 33, fig. 174
afra macrodiscus, Tropiometra, 265, 269, *272*, 273, 278; pl. 32, fig. 169
afra var. macrodiscus, Tropiometra, 273, 281
alaudae, Decametra, 170, 172, 173, *183*, 185, 187; pl. 23, figs. 114, 115
albopurpurea, Antedon, 137, 138, 139, 168
  Cyllometra, 138, 139, 156, 157, 158, 159, 160, 161, 168, 169
Alecto, 61, 260
  adeonae, 62, 74
  braziliensis, 325
  carinata, 289, 291, 320, 321, 322, 323, 324, 325, 326, 327, 331, 333, 334, 335
  encrinus, 282, 288, 289, 290
  macronema, 394, 395, 396, 401, 433
alecto, Calometra, 366, 367, 369, 370
  Neometra, 356, 358, 366, *367*, 369
Alisometra, 4, 5, 9, *112*, 117
  longipinna, *115*
  owstoni, 4, 97, *113*; pl. 13, figs. 65, 66
Amphimetra, 171
  discoidea, 291
  ensifer, 238
  flora, 188
  laevissima, 188
  milberti, 188
  molleri, 188, 190
  pinniformis, 209
  producta, 188
  sinensis, 198
  tessellata, 3
  tessellata discoidea, 267, 321
Ampullaria, 322
Analcidometra, 4, 5, 7, 52, 53, 60, 61, *77*, 78, 79, 89, 208, 209
  armata, 53, *79*, 80, 83, 84, 88, 251
  caribbea, 53, 56, 78, 79, 83, *84*, 88, 209; pl. 9, fig. 47
Andersoni group, 1, 6, 18
andersoni, Antedon, 6, 9, 10, 11, 17, 18, 19, 20
  Pontiometra, 5, *10*, 11, 20, 26; pl. 1, fig. 1; pl. 2, figs. 2–5; pl. 3, figs. 6–8
Andrometra, 253
angelini, Glenotremites, 10
angusticalyx, Antedon, 293
anisa, Iconometra, 89, 90, *97*, 102; pl. 9, figs. 45, 46; pl. 11, fig. 57; pl. 12, figs. 58–61
  Oligometra, 77, 90, 97, 101
annandalei, Oceanometra, 432
anomala, Antedon, 139, 168
  Cyllometra, 138, 145, 157, 159, 168
Antedon, 1, 6, 9, 10, 17, 18, 19, 20, 26, 42, 48, 61, 62, 66, 75, 76, 77, 78, 79, 83, 88, 90, 97, 105, 116, 117, 134, 135, 168, 170, 188, 204, 208, 215, 230, 255, 260, 264, 271, 287, 301, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 324, 327, 329, 331, 333, 340, 345, 351, 355, 375, 385, 394, 396, 401, 403, 412, 432
  abbotti, 27, 38, 42
  adeonae, 6, 62, 75, 76, 289, 337, 340, 341
  adriatica, 305, 306
  aequipinna, 156
  afer, 268, 271

Antedon afra, 268, 271, 280
  albopurpurea, 137, 138, 139, 168
  andersoni, 6, 9, 10, 11, 17, 18, 19, 20
  angusticalyx, 293
  anomala, 139, 168
  anthus, 439, 444, 459
  armata, 78, 79, 83, 84, 88
  aspera, 19
  basicurva, 330
  bella, 6, 27, 38, 39, 41, 42, 43, 44
  bella var. brunnea, 27, 41, 42
  bicolor, 293
  bidens, 6, 61, 62, 63, 65, 66, 75, 76, 77, 209
  bifida, 279, 292, 297, 306, 323, 325, 326, 331
  brasiliensis, 292, 293, 324, 325, 330, 333
  braziliensis, 261, 262, 292, 295, 323, 327, 329, 333
  callista, 385, 390
  capensis, 293, 294, 315, 330, 331, 333, 335
  carinata, 187, 217, 229, 231, 261, 262, 279, 281, 285, 287, 288, 292, 293, 294, 325, 326, 327, 328, 329, 330, 332, 334, 335, 337, 340, 341, 342, 343, 345
  carinatus, 292, 293, 324
  carpenteri, 5, 210, 213, 214, 215, 217, 229
  clarae, 6, 105, 108, 109, 110, 112, 137, 138, 167, 203, 204
  clemens, 41
  costata, 18
  cupulifera, 217, 231, 241, 243, 244
  cupuliferus, 237, 243
  cupuliferus var., 236, 237
  disciformis, 6, 110, 137, 138, 154, 155, 156, 158, 159, 167, 169
  discoidea, 369, 384, 386
  dubeni, 293, 323, 326
  dübeni, 293, 297, 299, 329, 331, 333, 335
  dubenii, 292, 293
  dübenii, 261, 294, 295, 324, 325, 327, 329, 331, 337
  elegans, 17, 18, 19
  emendatrix, 26, 28, 46, 48
  encrinus, 282, 287, 288
  fieldi, 104
  finschii, 11, 20
  flavopurpurea, 275, 379, 394
  gorgonia, 291, 320, 323, 324, 325, 327, 331
  iaponica, 94
  impinnata, 254, 255
  incerta, 435
  incisa, 330
  incommoda, 63, 75
  informis, 6, 118, 123, 203, 204, 205
Antedon insignis, 117, 118, 123, 124
  japonica, 6, 90, 94, 96, 97, 113, 115, 116, 244
  laevipinna, 75
  laevissima, 185, 187, 188, 205, 207, 208
  lineata, 83
  longicina, 439
  longicirra, 415, 433, 434, 435, 436, 437, 439, 441, 444, 459
  longicirri, 439
  lovéni, 6, 117, 118, 121, 123, 124, 135
  macrocnema, 401, 403, 412
  macrodiscus, 279, 280
  macronema, 393, 396, 397, 401, 402, 403, 408, 412, 413
  macropoda, 395, 432, 433, 441, 443, 444
  manca, 6, 110, 112, 134, 135, 137, 155, 158, 159, 167, 168, 169
  marginata, 41, 42, 155, 156
  marmorata, 282, 287, 288, 289
  mauonema, 403, 413
  mediterranea, 62, 75, 303, 305, 306, 321
  meridionalis, 323
  microdiscus, 18, 272
  milberti, 210, 211, 215, 271, 279
  moorei, 104
  mucronata, 296, 404
  multicolor, 167, 355, 369
  multiradiata, 18, 19
  palmata, 17
  perspinosa, 6, 116, 117, 118, 119, 122, 123, 124, 128
  pinniformis, 62, 75, 76, 77
  polypus, 11, 19
  prisca, 293, 324, 403
  propinqua, 352, 353, 354
  pumila, 121, 123
  rosacea, 279, 292, 326
  rosaceus, 62, 75
  scrobiculata, 19
  separata, 390, 391, 393
  serripinna, 5, 6, 90, 97, 116, 176, 177, 178, 208, 209, 210, 213, 214, 215, 217, 221, 229, 230, 241, 243, 244, 261
  sinensis, 197, 200
  sp., 10, 137, 288, 289, 293, 342, 345
  sp. (near macronema), 44, 45
  spicata, 46, 48
  suavis, 132
  tanneri, 138, 167
  thetis, 369
  tigrina, 178, 182
  versicolor, 351, 353, 354
  vicaria, 403, 413
  wilsoni, 402, 414, 415

Antedon (Cenometra) bella, 28
Antedon (Poecilometra) acoela, 385
Antedonidae, 135, 247, 253, 254, 395
Anthometra adriani, 375, 421
anthus, Antedon, 439, 444, 459
  Astererometra, 444
  Asterometra, 433, 434, 435, 436, 439, 443, *444*, 445, 446, 456, 457, 458, 459; pl. 36, fig. 194; pl. 41, figs. 212–214; pl. 42, fig. 215
  Ptilometra, 395, 444
Aporometra, 259, 395, 415
Aporometra occidentalis, 401, 402
  paedophora, 403, 404, 414
  wilsoni, 402, 414
arabica, Colobometra, 117, *132;* pl. 30, fig. 161
  Decametra, 172, *187*, 293
archeri, Kallispongia, 395, 403, 412, 414
armata, Antedon, 78, 79, 83, 84, 88
  Analcidometra, 53, *79*, 80, 83, 84, 88, 251
aspera, Antedon, 19
Astererometra anthus, 444
asteria, Cenocrinus, 321
Asterometra, 238, 258, 259, 394, 395, 415, 416, 417, 427, *432*, 433, 439, 441, 443, 459
  acerba, 444, 456, 457, 458, 459
  anthus, 433, 434, 435, 436, 439, 443, *444*, 445, 446, 456, 457, 458, 459; pl. 36, fig. 194; pl. 41, figs. 212–214; pl. 42, fig. 215
  cristata, 433, 434, 436, *437*, 439; pl. 40, figs. 209, 210; pl. 42, fig. 217
  lepida, 439, 441, 444, 445, 446, 457, 459
  longicirra, 433, 434, 436, 437, *439*, 440, 441, 445, 446
  macropoda, 257, 426, 433, 434, *441*, 443, 444, 445, 446, 458, 459; pl. 41, fig. 211
  magnipeda, 417, 426, 427, 432, 433, 441
  mirifica, 433, *434*, 435, 437, 439; pl. 40, fig. 208; pl. 42, fig. 216
  pulcherrima, 427, 432
  sp., 459
Asterometridae, 256, 257, 258, 259, 394, *415*, 417, 433
audouini, Tropiometra, 261, 262, 289, 293, 294, 299, 326, 337, 341, 342, 343, 345
  Tropiometra carinata, 266, *342;* pl. 35, figs. 185, 186; pl. 39, fig. 205
australis, Encrinus, 403, 411, 412, 414
  Ptilometra, 349, 350, 395, 396, 397, 398, 399, 401, 402, *403*, 404, 412, 413, 414; pl. 40, fig. 207
Austrometra, 4, 5, 7, 17, *52*, 53, 56, 57, 60, 61, 78, 79, 89, 208, 251
  thetidis, *53*, 56, 257
basicurva, Antedon, 330
  Charitometra, 330
Basicurva group, 18, 331, 415
Basilometra, 3, 4, 7, *21*, 22
  boschmai, *22;* pl. 5, figs. 16–19
bella, Antedon, 6, 27, 38, 39, 41, 42, 43, 44
  Antedon (Cenometra), 28
  Cenometra, *27*, 28, 32, 33, 42, 43; pl. 3, figs. 9, 10; pl. 5, figs. 20–24; pl. 6, fig. 25; pl. 7, figs. 28–30; pl. 8, fig. 37
  Himerometra, 27, 42
bella var. brunnea, Antedon, 27, 41, 42
  Cenometra, 28, 44
bella var. magnifica, Cenometra, 28, 30, 32, 43
belli, Cyllometra, 118, 123, 124, 135
bellona, Iconometra, 89, 90, *93*, 94
  Oligometrides, 93, 94
bengalensis, Heterometra, 351
bicolor, Antedon, 293
  Comatula, 292, 294, 323, 333, 335
bidens, Antedon, 6, 61, 62, 63, 65, 66, 75, 76, 77, 209
  Himerometra, 63, 76
  Oligometra, 55, 56, 63, 76, 202, 209
bifida, Antedon, 279, 292, 297, 306, 323, 325, 326, 331
boschmai, Basilometra, *22*, pl. 5, figs. 16–19
brachiolata, Comatulella, 396, 404
brasiliensis, Antedon, 292, 293, 324, 325, 330, 333
  Comatula, 291
braziliensis, Alecto, 325
  Antedon, 261, 262, 292, 295, 323, 327, 329, 333
  Tropiometra, 262, 293, 294
brevicirra, Colobometra (Prometra), 115, 117, 176, 178, 193, 194
  Decametra, 174, *193;* pl. 25, fig. 128
  Petasometra, 106, 108, 109
  Prometra, 171, 193, 194
brunnea, Antedon bella var., 27, 41, 42
  Cenometra, 28, 42
  Cenometra bella var. 28, 44

caledoniae, Oligometra, 216, 217, 229, 230, 231, 237, 244
  Oligometra serripinna, 217, 241
Callispongia, 395
callista, Antedon, 385, 390
  Calometra, 375, 383, 386, *390*, 391, 392, 393; pl. 36, fig. 193
Calometra, 259, 346, 347, 351, 354, 355, 369, 375, 381, 384, *385*, 390, 393
Calometra acanthaster, 363, 369, 370
  alecto, 366, 367, 369, 370

Calometra callista, 375, 383, 386, *390*, 391, 392, 393; pl. 36, fig. 193
  carduum, 376, 379
  diana, 360, 361, 370, 386
  discoidea, 360, *386*, 390
  flavopurpurea, 379
  magnifica, 377
  multicolor, 369, 370
  propinqua, 352, 354
  separata, 390
  spinosissima, 364, 366, 369, 370
  spinossima, 364, 366, 369
  thetis, 370
  versicolor, 352, 354
Calometra (Neometra) diana, 390
Calometra (Pectinometra) carduum, 384
Calometridae, 256, 257, 258, *346*, 347, 348, 351, 355, 375, 385, 394, 416
capensis, Antedon, 203, 294, 315, 330, 331, 333, 335
  Tropiometra, 294
capillastericola, Eulima, 74
caput-medusae, Pentacrinus, 321
carduum, Calometra, 376, 379
  Calometra (Pectinometra), 384
  Pectinometra, 375, *376*
caribbea, Analcidometra, 53, 56, 78, 79, 83, *84*, 88, 209; pl. 9, fig. 47
  Oligometra, 78, 84, 88, 202, 209
carinata, Actinometra, 293
  Alecto, 289, 291, 320, 321, 322, 323, 324, 325, 326, 327, 331, 333, 334, 335
  Antedon, 187, 217, 229, 231, 261, 262, 279, 281, 285, 287, 288, 292, 293, 294, 325, 326, 327, 328, 329, 330, 332, 334, 335, 337, 340, 341, 342, 343, 345
  Comatula, 260, 291, 294, 320, 321, 323, 325. 327, 330, 331, 332, 333, 344
  Comatula (Alecto), 291, 294, 321
  Tripiometra 295
  Tropiometra, 65, 259, 261, 262, 263, 264, 265, 266, 280, 282, 286, 287, 288, 289, 290, 293, 294, 301, 314, 319, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 340, 341, 342, 343, 344, 345
carinata audouini, Tropiometra, 266, *342;* pl. 35, figs. 185, 186; pl. 39, fig. 205
carinata carinata, Tropiometra, 266, *291;* pl. 35, figs. 183, 184; pl. 36, figs. 187, 188
carinata clarki, Tropiometra, 266, *281;* pl. 34, figs. 175–179; pl. 35, figs. 180–182
carinata indica, Tropiometra, 266, *337*
carinatus, Antedon, 292, 293, 324
carpenteri, Antedon, 5, 210, 213, 214, 215, 217, 229
  Oligometra, 4, 56, 90, 101, 202, 209, *210*, 215, 218, 232; pl. 29, figs. 157–160
Catoptometra, 5, 29
Cenocrinus asteria, 321
Cenometra, 1, 4, 6, 7, *26*, 27, 31, 32, 42, 46, 209
  abbotti, 28, 31, 42
  abotti, 28
  bella, *27*, 28, 32, 33, 42, 43; pl. 3, figs. 9, 10; pl. 5, figs. 20-24; pl. 6, fig. 25; pl. 7, figs. 28–30; pl. 8, fig. 37
  bella var. brunnea, 28, 44
  bella var. magnifica, 28, 30, 32, 43
  brunnea, 28, 42
  cornuta, 32, *44*, 45, 46
  delicata, 28, 33, 42
  emendatrix, 27, 32, 45, *46*, 48; pl. 8, fig. 34
  herdmani, 6, 27, 28, 32, 40, 42, *43*, 44; pl. 4, figs. 13-15; pl. 6, figs. 26, 27; pl. 7, figs. 31, 32; pl. 8, figs. 33, 35, 36
  herdmanni, 43
  insueta, 6, 28, 40, 42, 43, 44
  unicornis, 28, 33, 42, 43
chadwicki, Colobometra, 117, 171, 176, 178
  Colobometra (Prometra), 115, 176, 178, 193, 194
  Decametra, 5, 172, 173, *176*, 230
  Prometra, 176, 217
Charitometra, 60, 61, 255
  basicurva, 330
  incisa, 330
Charitometridae, 18, 57, 60, 256, 257, 258, 259, 346, 381, 385, 416
chinensis, Oligometra, 216, 230, 244, 246
  Oligometra serripinna, 216, *244;* pl. 27, fig. 144; pl. 28, fig. 152
clarae, Antedon, 6, 105, 108, 109, 110, 112, 137, 138, 167, 203, 204
  Cyllometra, 110, 112
  Petasometra, 105, *109*, 110, 112, 167; pl. 13, figs. 62–64
clarki, Tropiometra, 264, 282, 289, 294, 295, 298, 337, 338, 339, 341
  Tropiometra carinata, 266, *281*, pl. 34, figs. 175–179; pl. 35, figs. 180–182
Clarkometra, 5, 8, *246*, 247, 254, 255
  elegans, 246, *247*, 254, 255; pl. 26, figs. 137, 138
clemens, Antedon, 41
Colobometra, 1, 3, 4, 5, 6, 7, 8, 21, 25, *116*, 117, 123, 128, 176, 209
  arabica, 117, *132;* pl. 30, fig. 161
  chadwicki, 117, 171, 176, 178
  diadema, 117, 124, 122, *133*

Colobometra discolor, 5, 117, 124, *128*, 130, 131, 155; pl. 15, figs. 72–75; pl. 16, figs. 76–79
  perspinosa, 4, 6, *117*, 118, 120, 121, 123, 124, 127, 129, 132, 135; pl. 14, figs. 67–69
  perspinosa var. vepretum, *124*; pl. 14, fig. 70; pl. 15, fig. 71
  suavis, 117, 124, 129, *132*, 133; pl. 16, figs. 80, 81; pl. 17, fig. 82
  vepretum, 117, 118, 120, 122, 123, 124, 127, 128, 131
Colobometra (Prometra), 112, 171
  (Prometra) brevicirra, 115, 117, 176, 178, 193, 194
  chadwicki, 115, 176, 178, 193, 194
  owstoni, 113, 115, 117, 193
Colobometridae, *1*, 2, 3, 5, 6, 7, 10, 21, 26, 49, 52, 53, 56, 57, 60, 61, 62, 77, 78, 79, 89, 105, 113, 116, 134, 135, 171, 183, 208, 209, 247, 251, 254, 257, 258
Comantheria weberi, 63, 77
Comanthus, 279, 281
  japonica, 279
  parvicirra, 292, 326
  timorensis, 271
Comaster taviana, 63, 76
Comasteridae, 332
comata, Zygometra, 18, 68, 259
Comatilia, 116, 134, 259
Comatula, 61, 260, 327, 394
Comatula adeonae, 61, 62, 63, 65, 71, 74, 75, 76
  bicolor, 292, 294, 323, 333, 335
  brasiliensis, 291
  carinata, 260, 291, 294, 320, 321, 323, 325, 327, 330, 331, 332, 333, 342, 344
  laevissima, 188, 190
  macronema, 394, 395, 396, 397, 399, 400, 401, 404, 414
  mediterranea, 321
  multiradiata, 62, 74, 75
  picta, 291, 295, 322, 323, 333
  savignyi, 62
  solaris, 292, 323
  sp., 288, 289, 342, 344
Comatula (Alecto), 260
Comatula (Alecto), carinata, 291, 294, 321
Comatula (Antedon), 394
Comatula (Antedon) eschrichtii, 401
  macrocnema, 396, 401
  macronema, 403
Comatulella brachiolata, 396, 404
Comatulida, 1
Comatulida Oligophreata, 1, 6, 259
Compsometra lovéni, 121, 395, 403
  serrata, 308, 310
conaminis, Neometra, 356, *366*; pl. 36, fig. 191
concinna, Oligometra, 218, 224, 231
Corallina, 303, 320
coriaceum, Myzostomum, 123
Cosmiometra gardineri, 293
cornuta, Cenometra, 32, *44*, 45, 46
costata, Antedon, 18
costatus, Solanocrinus, 19
Cotylometra, 3, 4, 8, *48*, 52, 209
Cotylometra gracilicirra, 49, 209
  gracilicirra gracilicirra, *49*, 52; pl. 8, figs. 38–40; pl. 9, figs. 41, 42
  gracilicirra ornata, 49, *51*
  ornata, 51
cristata, Asterometra, 433, 434, 436, *437*, 439; pl. 40, figs. 209, 210; pl. 42, fig. 217.
cupulifera, Antedon, 217, 231, 241, 243, 244
cupuliferus, Antedon, 237, 243
cupuliferus var., Antedon 236, 237
Cyllometra, 1, 4, 5, 6, 7, 9, 10, 105, 116, 117, 124, *134*, 135, 158, 159, 168, 170, 202, 203, 204, 209, 255
Cyllometra albopurpurea, 138, 239, 156, 157, 158, 159, 160, 161, 168, 169
  anomala, 138, 145, 157, 159, 168
  belli, 118, 123, 124, 135
  clarae, 110, 112
  disciformis, 135, 138, 139, 158, 159, 160, 161, 168
  gracilis, 136, 138, 160, 168, *169*; pl. 18, figs. 88–90; pl. 19, fig. 97
  informis, 135, 202, 203, 205
  impinnata, 135, 255
  manca, 4, 110, 135, 136, *137*, 138, 139, 157, 158, 159, 160, 161, 167, 168, 169, 457; pl. 17, fig. 86; pl. 18, fig. 87; pl. 19, figs. 91–96; pl. 20, figs. 99, 100; pl. 21, fig. 101; pl. 22, figs. 102–108
  mollis, 191, 193, 203, 205
  perspinosa, 118, 135
  prashadi, *136*, 139; pl. 17, figs. 83–85
  pulchella, 135, 139, 144, 148, 159, 160, 161, 169, 457
  ruber, 135
  soluta, 6, 135, 137, 138, 157, 159, 168, 169
  sp., 208
  studeri, 200, 202, 203, 205
  suavis, 130
  taprobanes, 185
  tigrina, 135, 168, 178, 183
cysticolum, Myzostomum, 369, 379

dawydovi, Rhadinometra, 22, 25
Decametra, 1, 4, 5, 9, 104, 117, 135, *170*, 171, 172, 173, 175, 183, 187, 188, 190, 193, 194, 203, 205, 208, 209, 235, 247, 253
Decametra alaudae, 170, 172, 173, *183*, 185, 187; pl. 23, figs. 114, 115
  arabica, 172, *187*, 293
  brevicirra, 174, *193*; pl. 25, fig. 128
  chadwicki, 5, 172, 173, *176*, 230
  informis, 135, 156, 170, 172, 174, *203*, 204, 206; pl. 24, fig. 125
  intermedia, 172
  laevipinna, 172, 174, *197*, 198; pl. 22, fig. 109; pl. 25, figs. 129, 132
  macrobrachius, 235
  minima, 173, 174, *196*; pl. 25, fig. 131
  modica, 170, 172, 174, *205*, 207, 208; pl. 22, fig. 111; pl. 25, figs. 126, 127
  möbiusi, 170, 188, 203, 205, 206, 207, 208
  moebiusi, 205, 208
  mollis, 172, 173, 174, 189, 190, *191*, 193; pl. 24, fig. 122
  mylitta, 4, 96, 172, 173, 174, *188*, 190, 191; pl. 22, fig. 110; pl. 23, figs. 116, 117; pl. 24, fig. 118
  parva, 173, 174, *195*, 196; pl. 22, fig. 113
  sp., 208
  studeri, 172, 174, *200*, 201, 203, 206; pl. 24, fig. 121
  taprobanes, 170, 172, 173, 183, *185*, 187, 188; pl. 24, figs. 119, 120; pl. 25, fig. 130
  tigrina, 135, 168, 172, 173, *178*, 183; pl. 19, fig. 98; pl. 22, fig. 112; pl. 24, figs. 123, 124; pl. 26, fig. 133
  zebra, 172, 173, *175*
Decametra (Prometra), 104
Decametrocrinus, 293
Decametrocrinus vanhöffenianus, 331
Delesseria, 412
delicata, Cenometra, 28, 33, 42
diadema, Colobometra, 117, 124, 128, *133*
  Stenometra, 373
diana, Calometra, 360, 361, 370, 386
  Calometra (Neometra), 390
  Neometra, *360*, 363; pl. 37, figs. 195, 196
  Neometra (Calometra), 360
Dichrometra tenera, 295, 334
diomedeae, Perometra, 361
Diplocrinus maclearanus, 156
disciformis, Antedon, 6, 110, 137, 138, 154, 155, 156, 159, 167, 169
  Cyllometra, 135, 138, 139, 158, 159, 160, 161, 168
discoidea, Amphimetra, 291
  Amphimetra tessellata, 267, 321
  Antedon, 369, 384, 386
  Calometra, 360, *386*, 390
  Gephyrometra, 386
discolor, Colobometra, 5, 117, 124, *128*, 130, 131, 155; pl. 15, figs. 72–75; pl. 16, figs, 76–79
dorcadis, Ptilometra, 396, 397, 398, 401, 402, 404, 413, 414, 421, 432
dubeni, Antedon, 293, 323, 326
dübeni, Antedon, 293, 297, 299, 329, 331, 333, 335
dubenii, Antedon, 292, 293
dübenii, Antedon, 261, 294, 295, 324, 325, 327, 329, 331, 337

Echinus, 264
electrae, Oligometra, 216, 241
  Oligometra serripinna, 216
  Oligometra serripinna var., 241
elegans, Antedon, 17, 18, 19
  Clarkometra, 246, *247*, 254, 255; pl. 26, figs. 137, 138
  Zygometra, 18, 19
Elegans group, 1, 6, 11, 18, 19, 20
Embryometra, 5, 7, *251*, 254
  mortenseni, *251*
emendatrix, Antedon, 26, 28, 46, 48
  Cenometra, 27, 32, 45, *46*, 48; pl. 8, fig. 34
  Himerometra, 46
Encrinus, 394
  australis, 403, 411, 412, 414
encrinus, Alecto, 282, 288, 289, 290
  Antedon, 282, 287, 288
  Tropiometra, 261, 262, 263, 273, 281, 282, 288, 289, 290, 293, 294, 295, 332, 333, 334, 335, 337, 339, 340, 341, 342, 345
ensifer, Amphimetra, 238
Epimetra, 1, 2, 3, 4, 7, 8, 9, 10, 21, 25
  nympha, 10, 11, 20, *25*; pl. 4, figs. 11, 12
erinacea, Oligometra, 216, 237
  Oligometra serripinna var., 216, *237*, 238; pl. 28, figs. 148, 149
Erythrometra ruber, 135
eschrichtii, Comatula (Antedon), 401
Eudiocrinidae, 5, 257
Eudiocrinus indivisus, 49
  ornatus, 51
  pinnatus, 116
Eulima, 74, 373
  capillastericola, 74

fieldi, Antedon, 104
Fimbriata group, 259
finschii, Antedon, 11, 20

flabellum, Gorgonia (Rhipidogorgia), 229
flavopurpurea, Antedon, 375, 379, 384
  Calometra, 379
  Pectinometra, 375, 376, *379*, 380, 384, 385, 393; pl. 39, figs. 199, 200
  Pectiometra, 380
flora, Amphimetra, 188
Florometra, 333
  tanneri, 138, 167
fluctuans, Zygometra, 259
fruiticulosum, Lithothamnion, 340

gardineri, Cosmiometra, 293
Geometridae, 348
Gephyrometra, 346, 347, *351*, 355, 385
  discoidea, 386
  propinqua, 352, 355
  versicolor, *351*, 352, 355; pl. 36, fig. 189; pl. 39, fig. 204
gigas, Myzostomum, 315, 326
Gislénometra, 4, 7, *57*
  perplexa, *57*
glacialis, Heliometra, 271, 315, 401
Glenotremites angelini, 10
Glyptometra sclateri, 59
Gorgonia (Rhipidogorgia) flabellum, 229
gorgonia, Antedon, 291, 320, 323, 324, 325, 327, 331
  Neometra, 355, *356*, 358, 359; pl. 36, fig. 190
  Solanocrinus, 19
gracilicirra, Cotylometra, 49, 209
  Oligometra, 48, 49, 51, 202, 209
gracilicirra gracilicirra, Cotylometra, *49*, 52; pl. 8, figs. 38–40; pl. 9, figs. 41, 42
gracilicirra ornata, Cotylometra, 49, *51*
gracilicirra var. ornata, Oligometra, 49, 51, 52
gracilis, Cyllometra, 136, 138, 160, 168, *169;* pl. 18, figs. 88–90; pl. 19, fig. 97
Granulifera group, 18
group, Acoela, 66, 346, 385
  Andersoni, 1, 6, 18
  Basicurva, 18, 331, 415
  Elegans, 1, 6, 11, 18, 19, 20
  Fimbriata, 259
  Granulifera, 18
  Milberti, 1, 5, 6, 61, 62, 123, 229, 259, 331
  Multicolor, 346
  Palmata, 1, 6, 20, 158, 167
  Spinifera, 6, 18, 20, 104, 105, 393, 396, 401, 402, 403
  Tenella, 66, 77, 78, 80, 83
gyges, Lamprometra, 334
  Lamprometra palmata, 295

Halimeda, 214, 320
helianthoides, Petasometra, 4, *105*, 108, 109, 110, 112
Heliocidaris, 273
Heliometra, 167, 168, 333
  glacialis, 271, 315, 401
herdmani, Cenometra, 6, 27, 28, 32, 40, 42, *43*, 44; pl. 4, figs. 13–15; pl. 6, figs. 26, 27; pl. 7, figs. 31, 32; pl. 8, figs. 33, 35, 36
herdmanni, Cenometra, 43
Heterometra, 21
  bengalensis, 351
  quinduplicava, 41, 328
  savignii, 62, 106, 345
  savignyi, 62, 74
Himerometra, 1, 4, 5, 10, 26, 42, 48, 61, 62, 76
  abbotti, 27, 42
  bella, 27, 42
  bidens, 63, 76
  emendatrix, 46
  paedophora, 396, 403, 404, 413, 414, 415
  unicornis, 26, 27, 29, 42
Himerometridae, 1, 3, 5, 6, 9, 10, 20, 42, 97, 112, 123, 134, 183, 204, 208, 209, 215, 230, 258, 347
Homalometra, 347

iaponica, Antedon, 94
Iciligorgia sp., 214
Iconometra, 4, 9, 61, *88*, 89, 94, 102, 103, 105
  anisa, 89, 90, *97*, 102; pl. 9, figs. 45, 46; pl. 11, fig. 57; pl. 12, figs. 58–61
  bellona, 89, 90, *93*, 94
  intermedia, 90, *103*
  japonica, 4, 89, 90, *94*, 209, 244; pl. 10, figs. 53, 54; pl. 11, figs. 55, 56; pl. 26, figs. 134, 135
  marginata, 56, 89, 90, *102*, 103; pl. 10, figs. 50–52
  speciosa, 89, 90, *91*, 105; pl. 10, figs. 48, 49
  spinosa, 91
ijimai, Myzostoma, 272
imbricata, Oligometra, 202, 209, 216, 217, 236, 237
  Oligometra serripinna var., 216, 236
imperialis, Solanocrinus, 19
impinnata, Antedon, 254, 255
  Cyllometra, 135, 255
incerta, Antedon, 435
incisa, Antedon, 330
  Charitometra, 330
incommoda, Antedon, 63, 75
indica, Tropiometra, 261, 262, 263, 264, 288, 289, 293, 326, 337, 340, 341, 342, 345
  Tropiometra carinata, 266, *337*
  Stephanometra, 3, 4

indivisus, Eudiocrinus, 49
informis, Antedon, 6, 118, 123, 203, 204, 205
  Cyllometra, 135, 202, 203, 205
  Decametra, 135, 156, 170, 172, 174, *203*, 204, 206; pl. 24, fig. 125
insignis, Antedon, 117, 118, 123, 124
insperatus, Pontiometra, 10, 11, 12, 20
insueta, Cenometra, 6, 28, 40, 42, 43, 44
intermedia, Decametra, 172
  Inconometra, 90, *103*
  Oligometra, 76, 102, 103
  Oligometra (Prometra), 230
  Prometra, 103
Isometra vivipara, 308, 310

japonica, Antedon, 6, 90, 94, 96, 97, 113, 115, 116, 244
  Comanthus, 279
  Iconometra, 4, 89, 90, *94*, 209, 244; pl. 10, figs. 53, 54; pl. 11, figs. 55, 56; pl. 26, figs. 134, 135
  Oligometra, 94, 96, 97, 102, 113, 115, 116, 191, 202, 209, 244

Kallispongia, 394, 395
  archeri, 395, 403, 412, 414
kerguelensis, Promachocrinus, 331
klunzingeri, Lamprometra, 260

laevipinna, Antedon, 75
  Decametra, 172, 174, *197*, 198; pl. 22, fig. 109; pl. 25, figs. 129, 132
  Prometra, 171, 197
laevissima, Amphimetra, 188
  Antedon, 185, 187, 188, 205, 207, 208
  Comatula, 188, 190
Lamprometra, 5
  gyges, 334
  klunzingeri, 260
  palmata, 156
  palmata gyges, 295
lepida, Asterometra, 439, 441, 444, 445, 446, 457, 459
lineata, Antedon, 83
  Nemaster, 332, 335
Lithothamnion fruiticulosum, 340
longicina, Antedon, 439
longicirra, Antedon, 415, 433, 434, 435, 436, 437, 439, 441, 444, 459
  Asterometra, 433, 434, 436, 437, *439*, 440, 441, 445, 446
  Ptilometra, 395, 439
longicirri, Antedon, 439
longipinna, Alisometra, *115*
  Prometra, 94, 113, 115, 116, 117
lovéni, Antedon, 6, 117, 118, 121, 123, 124, 135
  Compsometra, 121, 395, 403

maclearanus, Diplocrinus, 156
  Pentacrinus, 156
macrobrachius, Decametra, 235
  Oligometra, 216
  Oligometra serripinna, 174
  Oligometra serripinna var., 173, 217, *232*, 235; pl. 27, figs. 141, 142
macrocnema, Antedon, 401, 403, 412
  Comatula (Antedon), 396, 401
macrodiscus, Antedon, 279, 280
  Tropiometra, 261, 264, 268, 271, 272, 279, 280, 281, 287, 331
  Tropiometra afra, 265, 269, *272*, 273, 278; pl. 32, fig. 169
  Tropiometra afra var., 273, 281
macronema, Alecto, 394, 395, 396, 401, 433
  Antedon, 393, 396, 397, 401, 402, 403, 408, 412, 413
  Comatula, 394, 395, 396, 397, 399, 400, 401, 404, 414
  Comatula (Antedon), 403
  Ptilometra, 324, *396*, 401, 402, 404, 407, 412, 413, 414, 415, 422, 423, 432; pl. 40, fig. 206
Macrophreata, 254, 416
macropoda, Antedon, 395, 432, 433, 441, 443, 444
  Asterometra, 257, 426, 433, 434, *441*, 443, 444, 445, 446, 458, 459; pl. 41, fig. 211
  Ptilometra, 395, 441
magnifica, Calometra, 377
  Cenometra bella var., 28, 30, 32, 43
  Tropiometra, *266*, 268; pl. 33, figs. 170–173
  Pectinometra, 349, 375, *377*; pl. 39, figs. 201, 202
magnipeda, Asterometra, 417, 426, 427, 432, 433, 441
  Pterometra, 416, 417, *426*, 432
manca, Antedon, 6, 110, 112, 134, 135, 137, 155, 158, 159, 167, 168, 169
  Cyllometra, 4, 110, 135, 136, *137*, 138, 139, 157, 158, 159, 160, 161, 167, 168, 169, 457; pl. 17, fig. 86; pl. 18, fig. 87; pl. 19, figs. 91–96; pl. 20, figs. 99, 100; pl. 21, fig. 101; pl. 22, figs. 102–108
marginata, Antedon, 41, 42, 155, 156
  Iconometra, 56, 89, 90, *102*, 103; pl. 10, figs. 50–52
  Oligometra, 56, 63, 77, 90, 102, 103
mariae, Oreometra, 347, 348, 351, 396
  Reometra, 348, 350, 359
Mariametra vicaria, 413
Mariametrida, 1, 2, 3, 5, 7, 257, 258
Mariametridae, 3, 5, 9, 10, 258

marmorata, Antedon, 282, 287, 288, 289
mauonema, Antedon, 403, 413
mediterranea, Antedon, 62, 75, 303, 305, 306, 321
    Comatula, 321
Melanella, 373
meridionalis, Antedon, 323
Metacrinus sp., 53
microdiscus, Antedon, 18, 272
    Zygometra, 15, 18, 19, 396
milberti, Antedon, 210, 211, 215, 271, 279
    Amphimetra, 188
Milberti group, 1, 5, 6, 61, 62, 123, 229, 259, 331
minima, Decametra, 173, 174, *196*; pl. 25, fig. 131
    Prometra, 171, 196, 197
mirifica, Asterometra, 433, *434*, 435, 437, 439; pl. 40, fig. 208; pl. 42, fig. 216
modica, Decametra, 170, 172, 174, *205*, 207, 208; pl. 22, fig. 111; pl. 25, figs. 126, 127
moebiusi, Decametra, 205, 208
molleri, Amphimetra, 188, 190
mollis, Cyllometra, 191, 193, 203, 205
    Decametra, 172, 173, 174, 189, 190, *191*, 193; pl. 24, fig. 122
moorei, Antedon, 104
mortenseni, Embryometra, *251*
mucronata. Antedon, 396, 404
muelleri, Ptilometra, 404
mülleri, Ptilometra, 396, 402, 403, 404, 412, 413, 414
multicolor, Antedon, 167, 355, 369
    Calometra, 369, 370
    Neometra, 167, 349, 356, 359, 361, 363, 364, 365, 368, *369*, 370, 383, 391, 393; pl. 36, fig. 192
Multicolor group, 346
multicor, Neometra, 370
multiradiata, Antedon, 18, 19
    Comatula, 62, 74, 75
mylitta, Decametra, 4, 96, 172, 173, 174, *188*, 190, 191; pl. 22, fig. 110; pl. 23, figs. 116, 117; pl. 24, fig. 118
Mytilus, 322
Myzostoma, 277
    ijimai, 272
Myzostomum coriaceum, 123
    cysticolum, 369, 379
    gigas, 315, 326

Nemaster, 259
    lineata, 332, 335
    rubiginosa, 332, 335
Neometra, 346, 347, *355*, 361, 366, 367, 369, 381, 385
    acanthaster, 348, 356, *363*, 364, 368
    alecto, 356, 358, 366, *367*, 369
Neometra conaminis, 356, *366*; pl. 36, fig. 191
    diana, *360*, 363; pl. 37, figs. 195, 196
    gorgonia, 355, *356*, 358, 359; pl. 36, fig. 190
    multicolor, 167, 349, 356, 359, 361, 363, 364, 365, 368, *369*, 370, 383, 391, 393; pl. 36, fig. 192
    multicor, 370
    pulchella, 301
    sappho, 356, *361*
    sibogae, 348, 351, 355, *358*, 370; pl. 38, figs. 197, 198
    spinosissima, 356, *364*, 368; pl. 39, fig. 203
Neometra (Calometra) diana, 360
Notocrinida, 394, 416
Notocrinidae, 416
Notocrinus virilis, 308
nympha, Epimetra, 10, 11, 20, *25*; pl. 4, figs. 11, 12

Oceanometra annandalei, 432
occidentalis, Aporometra, 401, 402
    Oligometra, 94, 216, 217, 218, 222, 230, 239, 240, 243, 244
    Oligometra serripinna, 218, 239, 240
    Oligometra serripinna var., 216, 217, *239*, 240; pl. 26, fig. 136; pl. 28, figs. 150, 151; pl. 30, fig. 163
Oligemetrides, 61
Oligemetrides adeonae, 63
Oligometra, 1, 5, 6, 7, 9, 10, 48, 52, 56, 61, 62, 76, 77, 78, 88, 89, 90, 97, 101, 104, 112, 135, 170, 202, *208*, 209, 215, 231, 235, 237, 240, 241, 246
    adeonae, 53, 55, 56, 62, 63, 67, 76, 77, 90, 102, 202, 209, 260
    adeonae form scabra, 63, 71, 72
    anisa, 77, 90, 97, 101
    bidens, 55, 56, 63, 76, 202, 209
    caledoniae, 216, 217, 229, 230, 231, 237, 244
    caribbea, 78, 84, 88, 202, 209
    carpenteri, 4, 56, 90, 101, 202, 209, *210*, 215, 218, 232; pl. 29, figs. 157–160
    chinensis, 216, 230, 244, 246
    concinna, 218, 224, 231
    electrae, 216, 241
    erinacea, 216, 237
    gracilicirra, 48, 49, 51, 202, 209
    gracilicirra var. onnata, 49, 51, 52
    imbricata, 202, 209, 216, 217, 236, 237
    intermedia, 76, 102, 103
    japonica, 94, 96, 97, 102, 113, 115, 116, 191, 202, 209, 244
    macrobrachius, 216
    marginata, 56, 63, 77, 90, 102, 103
    occidentalis, 94, 216, 217, 218, 222, 230, 239, 240, 243, 244

Oligometra pinniformis, 202, 209
pulchella, 202, 209, 217, 218, 222, 224, 230, 231
serripinna, 49, 56, 94, 104, 115, 153, 178, 181, 188, 193, 202, 209, *216*, 217, 218, 230, 231, 232, 234, 235, 236, 237, 238, 239, 240, 241, 242, 244, 246
serripinna caledoniae, 217, 241
serripinna electrae, 216
serripinna chinensis, 216, *244*; pl. 27, fig. 144; pl. 28, fig. 152
serripinna macrobrachius, 174
serripinna occidentalis, 218, 239, 240
serripinna serripinna, 216, *217*, 218, 234; pl. 27, fig. 143; pl. 28, figs. 153–155; pl. 29, fig. 156
serripinna var. electrae 241
serripinna var. erinacea, 216, *237*, 238; pl. 28, figs. 148, 149.
serripinna var. imbricata, 216, 236
serripinna var. macrobrachius, 173, 217, *232*, 235; pl. 27, figs. 141, 142
serripinna var. occidentalis, 216, 217, *239*, 240; pl. 26, fig. 136; pl. 28, figs. 150, 151, pl. 30, fig. 163
studeri, 49, 63, 76, 84, 88, 94, 200, 201, 202 210, 217, 236
thetidis, 52, 53, 55, 56. 63, 76, 77, 84, 88, 102
zebra, 175, 176
Oligometra (Decametra) studeri, 115, 215, 236
Oligometra (Prometra) intermedia, 230
Oligometrides, 4, 8, 52, 53, *61*, 62, 78, 79, 89, 208, 209, 276
adeonae, 6, 52, 58, *62*, 63, 74, 77, 90, 93, 97, 101, 102, 103, 104, 209; pl. 9, figs. 43, 44
bellona, 93, 94
thetidis, 53, 56
Oligophreata, 1, 2, 346, 347
Oligophreata, Comatulida, 1, 6, 259
Ophiothela sp., 214.
Oreometra, 346, 347
mariae, 347, 348, 351, 396
pericalles, 348, 349, 350, 351
orion, Parametra, 265
ornata, Cotylometra, 51
Cotylometra gracilicirra, 49, *51*
Oligometra gracilicirra var. 49, 51, 52
ornatus, Eudiocrinus, 51
owstoni, Alisometra, 4, 97, *113*; pl. 13, figs. 65, 66
Colobometra (Prometra), 113, 115, 117, 193
Prometra, 94, 97, 113, 115, 116, 117
Pachylometra, 57
sclateri, 57, 59, 60
paedophora, Aporometra, 403, 404, 414
Himerometra, 396, 403, 404, 413, 414, 415
palmata, Antedon, 17
Lamprometra, 156
Palmata group, 1, 6, 20, 158, 167
palmata gyges, Lamprometra, 295
Parametra orion, 265
parva, Decametra, 173, 174, *195*, 196; pl. 22, fig. 113
Prometra, 171, 195, 196
parvicirra, Actinometra, 292, 293, 326
Comanthus, 292, 326
Pectinometra, 346, 347, 351, *375*, 384, 385, 393
carduum, 375, *376*
flavopurpurea, 375, 376, *379*, 380, 384, 385, 393; pl. 39, figs. 199, 200
magnifica, 349, 375, *377*; pl. 39, figs. 201, 202
separata, 390
versicolor, 352, 354
Pectiometra, 375
flavopurpurea, 380
Pentacrinus caput-medusae, 321
maclearanus, 156
pericalles, Oreometra, 348, 349, 359, 351
Reometra, 348
Perometra diomedeae, 238, 361
Perometrinae, 135, 160, 247, 253, 254
perplexa, Gislénometra, *57*
Prometra, 178, 180, 183, 217, 244
perspinosa, Antedon, 6, 116, 117, 118, 119, 122, 123, 124, 128
Colobometra, 4, 6, *117*, 118, 120, 121, 123, 124, 127, 129, 132, 135; pl. 14, figs. 67–69
Cyllometra, 118, 135
perspinosa var. vepretum, Colobometra, *124*, pl. 14, fig. 70; pl. 15, fig. 71
Petasometra, 4, 5, 8, 21, *105*, 109, 112, 134, 170
brevicirra, 106, 108, 109
clarae, 105, *109*, 110, 112, 167; pl. 13, figs. 62–64
helianthoides, 4, *105*, 108, 109, 110, 112
variegata, 106, 107, 108, 109
picta, Comatula, 291, 295, 322, 323, 333
Tropiometra, 261, 262, 264, 282, 288, 289, 291, 292, 293, 294, 333, 334, 335, 336, 337, 340
pinnatus, Eudiocrinus, 116
pinniformis, Antedon, 62, 75, 76, 77
Amphimetra, 209
Oligometra, 202, 209

polypus, Antedon, 11, 19
  Pontiometra, 11
Pontiometra, 1, 3, 4, 6, 7, *9*, 10, 20, 21, 25
Pontiometra andersoni, 5, *10*, 11, 20, 26; pl. 1, fig. 1; pl. 2, figs. 2–5; pl. 3, figs. 6–8
  insperatus, 10, 11, 12, 20
  polypus, 11
Pontiomètres, 2, 6
Pontiometridae, 1, 2, 6, 7, 9, 10
Porites, 320
Posidonia, 309
prashadi, Cyllometra, *136*, 139; pl. 17, figs. 83–85
priamus, Strotometra, 385
prisca, Antedon, 293, 324, 403
producta, Amphimetra, 188
Promachocrinus kerguelensis, 331
Prometra, 5, 77, 104, 112, 113, 115, 116, 117, 130, 170, 171, 178, 183, 247
  brevicirra, 171, 193, 194
  chadwicki, 176, 217
  intermedia, 103
  laevipinna, 171, 197
  longipinna, 94, 113, 115, 116, 117
  minima, 171, 196, 197
  owstoni, 94, 97, 113, 115, 116, 117
  parva, 171, 195, 196
  perplexa, 178, 180, 183, 217, 244
Prometra (Decametra), 171
propinqua, Antedon, 352, 353, 354
  Calometra, 352, 354
  Gephyrometra, 352, 355
protectus, Stephanometra, 3, 102, 155, 156
Pterometra, 258, 394, 395, 407, 415, *416*, 417, 425, 427, 432, 433
  magnipeda, 416, 417, *426*, 432
  pulcherrima, 416, 417, *427*; pl. 43, figs. 218, 219
  splendida, 418, 419, *420*, 421
  trichopoda, 418, 419, 420, *421*, 427
  venusta, *418*, 421; pl. 43, fig. 220
Ptilometra, 259, *394*, 395, 396, 401, 403, 404, 413, 415, 416, 417, 432, 433, 441, 443, 459
  anthus, 395, 444
  australis, 349, 350, 395, 396, 397, 398, 399, 401, 402, *403*, 404, 412, 413, 414; pl. 40, fig. 207
  dorcadis, 396, 397, 398, 401, 402, 404, 413, 414, 421, 432
  longicirra, 395, 439
  macronema, 324, *396*, 401, 402, 404, 407, 412, 413, 414, 415, 422, 423, 432; pl. 40, fig. 206
  macropoda, 395, 441
  mülleri, 396, 402, 403, 404, 412, 413, 414
  muelleri, 404
  pulcherrima, 427, 432
Ptilometra splendida, 420
  trichopoda, 404, 416, 417, 421, 425, 432
Ptilometra (Pterometra) trichopoda, 413
Ptilometridae, 256, 257, 258, *393*, 394
Ptilometrinae, 258, 393, 394, 415, 416
pulchella, Cyllometra, 135, 139, 144, 148, 159, 160, 161, 169, 457
  Neometra, 301
  Oligometra, 202, 209, 217, 218, 222, 224, 230, 231
pulcherrima, Asterometra, 427, 432
  Pterometra, 416, 417, *427*; pl. 43, figs. 218, 219
  Ptilometra, 427, 432
pumila, Antedon, 121, 123

quinduplicava, Heterometra, 41, 328

Reometra, *347*, 348, 351
  mariae, *348*, 350, 359
  pericalles, 348
Rhadinometra, 21, 22
  dawydovi, 22, 25
rosacea, Antedon, 279, 292, 326
rosaceus, Antedon, 62, 75
ruber, Cyllometra, 135
  Erythrometra, 135
rubiginosa, Nemaster, 332

Sabinella, 74, 373
sappho, Neometra, 356, *361*
savignii, Heterometra, 62, 106, 345
savignyi, Comatula, 62
  Heterometra, 62, 74
scabra, Oligometra adeonae form, 63, 71, 72
sclateri, Glyptometra, 59
  Pachylometra, 57, 59, 60
scrobiculata, Antedon, 19
separata, Antedon, 390, 391, 393
  Calometra, 390
  Pectinometra, 390
serrata, Compsometra, 308, 310
serripinna, Antedon, 5, 6, 90, 97, 116, 176, 177, 178, 208, 209, 210, 213, 214, 215, 217, 221, 229, 230, 241, 243, 244, 261
  Oligometra, 49, 56, 94, 104, 115, 153, 178, 181, 188, 193, 202, 209, *216*, 217, 218, 230, 231, 232, 234, 235, 236, 237, 238, 239, 240, 241, 242, 244, 246, 293
serripinna caledoniae, Oligometra, 217, 241
serripinna chinensis, Oligometra, 216, *244*; pl. 27, fig. 144; pl. 28, fig. 152
serripinna electrae, Oligometra, 216
serripinna macrobrachius, Oligometra, 174

serripinna occidentalis, Oligometra, 218, 239, 240
serripinna serripinna, Oligometra, 216, *217*, 218, 234; pl. 27, fig. 143; pl. 28, figs. 153–155; pl. 29, fig. 156
serripinna var. electrae, Oligometra, *241*
serripinna var. erinacea, Oligometra, 216, *237*, 238; pl. 28, figs. 148, 149
serripinna var. imbricata, Oligometra, 216, 236
serripinna var. macrobrachius, Oligometra, 173, 217, *232*, 235; pl. 27, figs. 141, 142
serripinna var. occidentalis, Oligometra, 216, 217, *239*, 240; pl. 26, fig. 136; pl. 28, figs. 150, 151; pl. 30, fig. 163
sibogae, Neometra, 348, 351, 355, *358*, 370; pl. 38, figs. 197, 198
sinensis, Antedon, 197, 200
  Amphimetra, 198
Solanocrinus, 18, 19, 401
  costatus, 19
  gracilis, 19
  imperialis, 19
solaris, Actinometra, 333, 334, 335
  Comatula, 292, 323
Solen, 322
soluta, Cyllometra, 6, 135, 137, 138, 157, 159, 168, 169
speciosa, Iconometra, 89, 90, *91*, 105; pl. 10, figs. 48, 49
Spinifera group, 6, 18, 20, 104, 105, 393, 396, 401, 402, 403
spinosa, Iconometra, 91
spinosissima, Neometra, 356, *364*, 368; pl. 39, fig. 203
splendida, Pterometra, 418, 419, *420*, 421
  Ptilometra, 420
spicata, Antedon, 46, 48
  Stephanometra, 41, 42
spinosissima, Calometra, 364, 366, 369, 370
spinossima, Calometra, 364, 366, 369
Stenometra diadema, 373
Stephanometra, 78, 104, 297, 343
Stephanometra indica, 3, 4
  protectus, 3, 102, 155, 156
  spicata, 41, 42
Stephanometridae, 78
Strotometra priamus, 385
studeri, Cyllometra, 200, 202, 203, 205
  Decametra, 172, 174, *200*, 201, 203, 206; pl. 24, fig. 121
  Oligometra, 49, 63, 76, 84, 88, 94, 200, 201, 202, 210, 217, 236
  Oligometra (Decametra), 115, 215, 236
Stylometra, 238
suavis, Antedon, 132
  Colobometra, 117, 124, 129, *132*, 133; pl. 16, figs. 80, 81; pl. 17, fig. 82
  Cyllometra, 130

tanneri, Antedon, 138, 167
  Florometra, 138, 167
taprobanes, Cyllometra, 185
  Decametra, 170, 172, 173, 183, *185*, 187, 188; pl. 24, figs. 119, 120, pl. 25, fig. 130
taviana, Comaster, 63, 76
Tenella group, 66, 77, 78, 80, 83
tenera, Dichrometra, 295, 334
tessellata, Amphimetra, 3
tessellata discoidea, Amphimetra, 267, 321
testudinum, Thalassia, 303
Thalassia, 303
  testudinum, 303
Thalassometra, 255
Thalassomètres, 393, 415
Thalassometrida, 255, 394, 416
Thalassometridae, 18, 20, 256, 257, 258, 259, 265, 381, 393, 394, 395, 407, 415, 416, 417
Thalassometriden, 393, 415
Thalassometrinae, 258, 393, 394, 415
Thalassometroida, 255
thetidis, Austrometra, *53*, 56, 257
  Oligometra, 52, 53, 55, 56, 63, 76, 77, 84, 88, 102
  Oligometrides, 53, 56
thetis, Calometra, 370
Thopimetridae 260
tigrina, Antedon, 178, 182
  Cyllometra, 135, 168, 178, 183
  Decametra, 135, 168, 172, 173, *178*, 183; pl. 19, fig. 98; pl. 22, fig. 112; pl. 24, figs. 123, 124; pl. 26, fig. 133
timorensis, Comanthus, 271
trichopoda, Pterometra, 418, 419, 420, *421*, 427
  Ptilometra, 404, 416, 417, 421, 425, 432
  Ptilometra (Pterometra), 413
Tripiometra, 261
  carinata, 295
Tripiometridae, 260
Tropimetra, 261, 264
Tropiometra, 64, 71, 255, 259, *260*, 261, 262, 264, 265, 279, 281, 288, 289, 290, 303, 304, 307, 308, 310, 311, 312, 317, 319, 320, 326, 330, 334, 335, 336, 342, 344, 345
  afra, 261, 263, 264, 265, 268, 271, 272, 273, 274, 280, 281, 286, 288, 289, 331, 334
  afra afra, 265, *268;* pl. 31, figs. 166, 167; pl. 32, fig. 168; pl. 33, fig. 174

Tropiometra afra macrodiscus, 265, 269, *272*, 273, 278; pl. 32, fig. 169
  afra var. macrodiscus, 273, 281
  audouini, 261, 262, 289, 293, 294, 299, 326, 337, 341, 342, 345
  braziliensis, 262, 293, 294
  capensis, 294
  carinata, 65, 259, 261, 262, 263, 264, 265, 266, 280, 282, 286, 287, 288, 289, 290, 293, 294, 301, 314, 319, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 340, 341, 342, 343, 344, 345
  carinata audouini, 266, *342;* pl. 35, figs. 185, 186; pl. 39, fig. 205
  carinata carinata, 266, *291;* pl. 35, figs. 183, 184; pl. 36, figs. 187, 188
  carinata clarki, 266, *281;* pl. 34, figs. 175–179,; pl. 35, figs. 180–182
  carinata indica, 266, *337*
  clarki, 264, 282, 289, 294, 295, 298, 337, 338, 339, 341
  encrinus, 261, 262, 263, 273, 281, 282, 288, 289, 290, 293, 294, 295, 332, 333, 334, 335, 337, 339, 340, 341, 342, 345
  indica, 261, 262, 263, 264, 288, 289, 293, 326, 337, 340, 341, 342, 343, 345
  macrodiscus, 261, 264, 268, 271, 272, 279, 280, 281, 287, 331
  magnifica, 265, *266*, 268; pl. 33, figs. 170–173
  picta, 261, 262, 264, 282, 288, 289, 291, 292, 293, 294, 333, 334, 335, 336, 337, 340
  sp., 62, 282, 287, 294, 295, 337, 340
Tropiomètres, 260
Tropiometrida, 255, 256, 258, 260, 346, 393, 415, 416
Tropiometridae, 256, 257, 258, *259*, 260, 261, 294, 385, 394, 416, 432

Udothea, 303
unicornis, Cenometra, 28, 33, 42, 43
  Himerometra, 26, 27, 29, 42

vanhöffenianus, Decametrocrinus, 331
variegatus, Petasometra, 106, 107, 108, 109
venusta, Pterometra, *418*, 421; pl. 43, fig. 220
vepretum, Colobometra, 117, 118, 120, 122, 123, 124, 127, 128, 131
  Colobometra perspinosa var., *124;* pl. 14, fig. 70; pl. 15, fig. 71
versicolor, Antedon, 351, 353, 354
  Calometra, 352, 354
  Gephyrometra, *351*, 352, 355; pl. 36, fig. 189; pl. 39, fig. 204.
  Pectinometra, 352, 354
vicaria, Antedon, 403, 413
  Mariametra, 413
virilis, Notocrinus, 308
vivipara, Isometra, 308, 310

weberi, Comantheria, 63, 77
wilsoni, Antedon, 402, 414, 415
  Aporometra, 402, 414

zebra, Decametra, 172, 173, *175*
  Oligometra, 175, 176
Zostera, 320
Zygometra, 3, 56
  comata, 18, 68, 259
  elegans, 18, 19
  fluctuans, 259
  microdiscus, 15, 18, 19, 396
Zygometridae, 5, 257, 346, 351

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01421 1346